

How Korea responded to a pandemic using ICT

Flattening the curve on COVID-19

April 15, 2020



The Government of
the Republic of Korea

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(to be updated)

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the Republic of Korea

¹ This document is prepared by joint collaboration of Korean government ministries and agency including Ministry of Economy and Finance, Ministry of Science and ICT, Ministry of the Interior and Safety, Ministry of Health and Welfare, Ministry of Land, Infrastructure and Transport and Korean Intellectual Property Office. For general inquire, please contact at djlee2@korea.kr (Dae J Lee), hjlee830@korea.kr (Hyunji Lee), junseokpark@korea.kr (Junsuk Park).

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Flattening the Curve on COVID-19: The Korean Experience



“Korea will play an active role to promote international solidarity in COVID-19 responses. There will also be a lot of room for cooperation on COVID-19 responses”

President Moon Jae-in
Republic of Korea

April 8, 2020
Phone Conference to President of Republic of Estonia

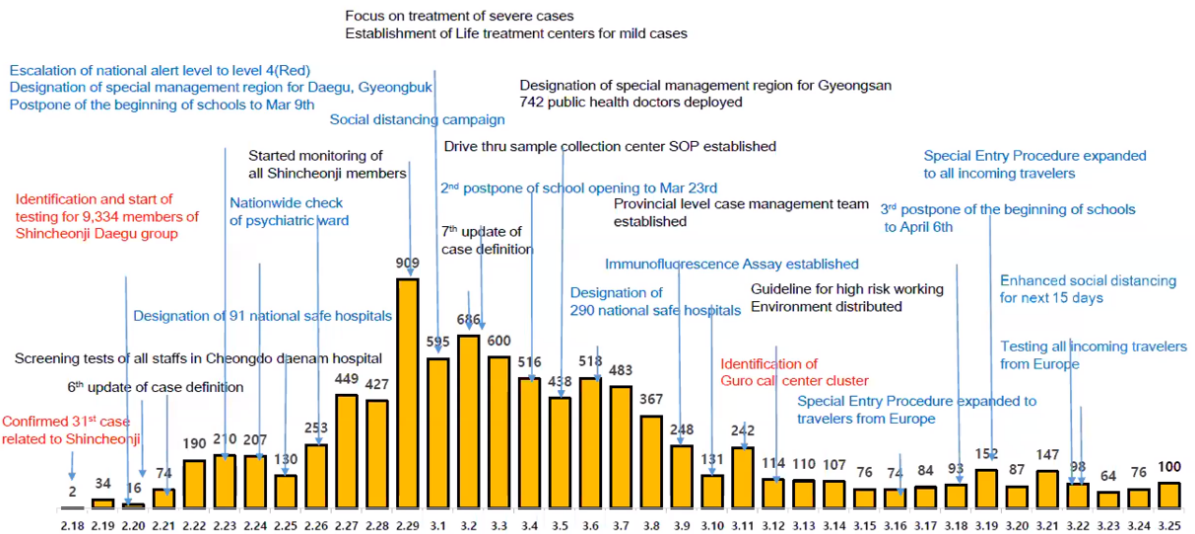
As President Moon Jae-in of the Republic of Korea said, “the impact of the health and economic crisis caused by COVID-19 is the first of its kind.” In order to overcome this crisis, it is very important to make joint efforts at both regional and national level, as well as globally. This paper is a summary of Korea’s comprehensive response against COVID-19 using ICT and other innovative technologies over the past three months from January to April 15, 2020.

1. INTRODUCTION



1. Introduction

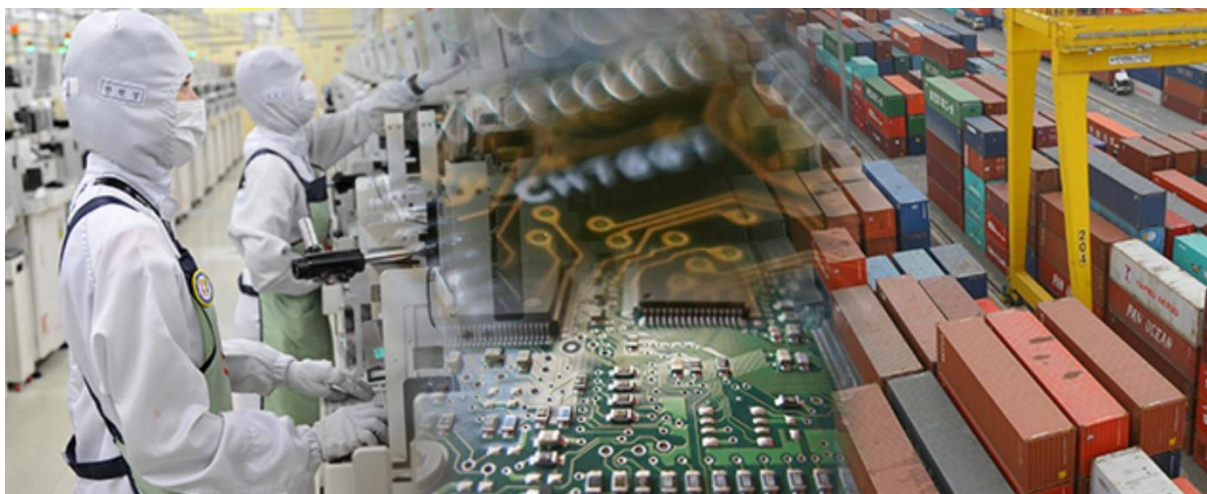
Figure 1 New case of COVID-19 and speedy response of Korean authority



With the spread of COVID-19, the world is facing an unprecedented economic, social and political crisis. Global leaders and experts said COVID-19 is and will be “the gravest challenge since the World War II.” Korea is no exception in this global pandemic. Korea had a surge of COVID-19 outbreak and virus started spreading at the local and community level. The number of new coronavirus cases increases exponentially peaking at 909 new infections on February 29. But new case has dropped significantly. Korea was able to successfully flatten the curve on COVID-19 in only 20 days without enforcing extreme draconian measures that restrict freedom and movement of people.

What is the secret of Korea's successful response?

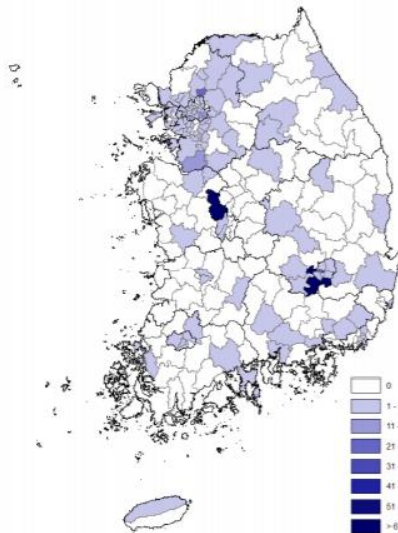
Picture 1 How Korea responded to a pandemic using ICT



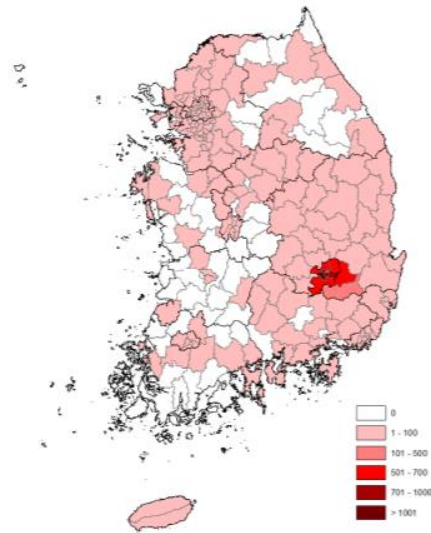
Recent Outbreak Situation of COVID-19 in Korea (As of April 4, 2020)

By gender, women accounted for 59.9% more than men. In particular, the proportion of women in their twenties and higher was high. The average age of the confirmed patients was 44.1 years (median age 45 years), and those in their 20s and 50s were 69.8%. In particular, the 20s showed a higher percentage of 27.3% (2,799) than other age groups. The median age of death was 77. 2 years (median age 79 years). The fatality rate among all confirmed patients was 1.79%, and the fatality rate over 80 years old was the highest at 19.57%.

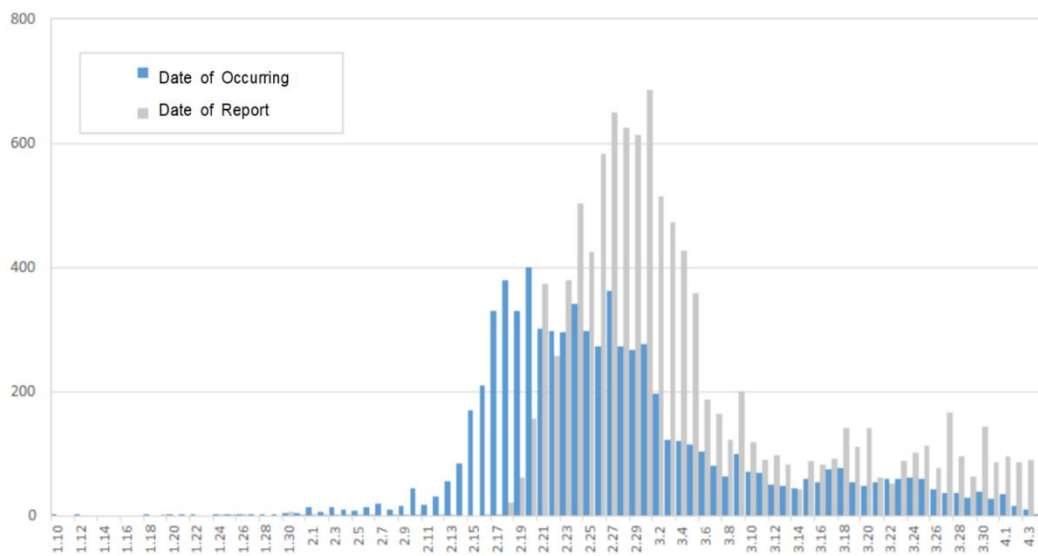
<Week 14 New Reported Cases of COVID-19>



<Total Reported Cases of COVID-19>



Recently, the increase and decrease have been repeated within 100 people per day, and an average of 88 people per day occurred on the 14th week (March 29 to April 4) 70.9% (7,278 patients) of patients with the first symptom onset (onset date) had a median of 3 days (mean 4.5 days) from the onset of diagnosis to the diagnosis of the confirmed patient.



< Average of 4.5 days of time lag report >

ICTs played a vital role in fighting COVID-19 in Korea. Mobile devices were used to support early testing and contact tracing. Advanced ICTs were particularly useful in spreading key emergency information on novel virus and help to maintain extensive 'social distancing'. The testing results and latest information on COVID-19 was made available via national and local government websites. The government provided free smartphone apps flagged infection hotspots with text alerts on testing and local cases. In the publication, we will present actual response measures of Korean government against COVID-19 using the latest ICTs and discuss how we can fight smarter against an invisible micro-pathogen. We hope the information and experience of Korea may provide a valuable solution to help your country and community combat COVID-19.

2. ICT helps SOCIAL DISTANCING



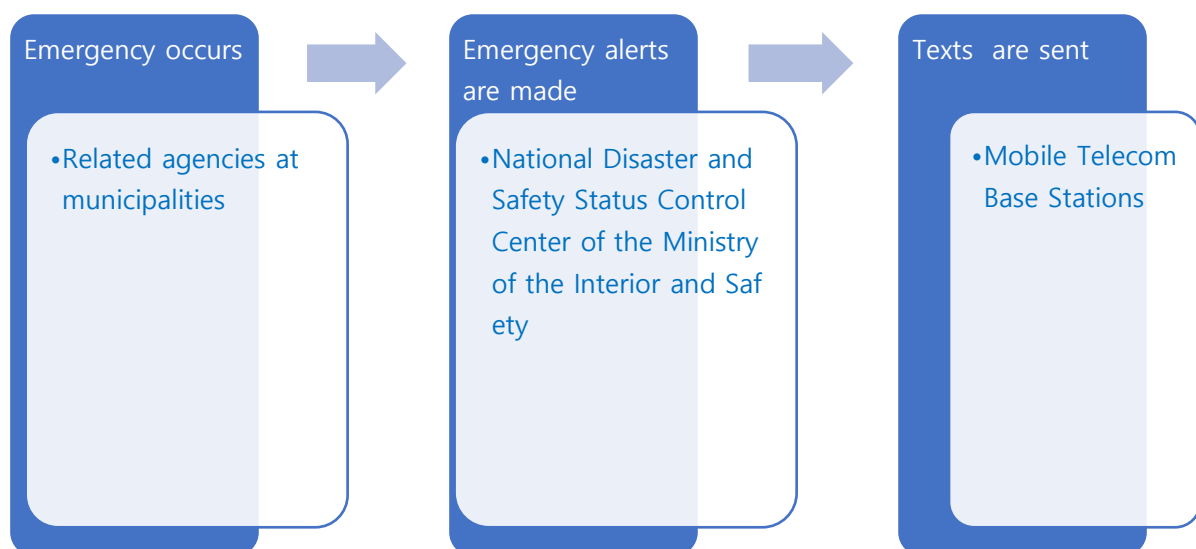
2. ICT helps SOCIAL DISTANCING

2.1 Emergency broadcasting service (CBS, cellular broadcasting service)

The Cellular Broadcasting Service, or CBS, enables government agencies to transmit emergency alert text messages on natural or manmade disasters to cell phones through mobile telecom carriers in Korea. The CBS can send these messages without a delivery bottleneck when an emergency occurs because it does not use the general SMS text messaging system. Moreover, it delivers messages to subscribers' mobile phones in a way such that a customized warning alarm only goes off in the disaster area. In general, the system sends short messages with emergency alerts and guidelines for citizens. Messages are categorized into three types based on the severity of the disaster. The most urgent emergency disaster messages such as an air raid warning and NBC warning are transmitted during wartime with the alarm sounding at a volume above 60 decibels, and it is impossible to ignore the texts. The second highest-risk notification about emergent disasters sends an alert exceeding 40 decibels when a disaster occurs. Finally, safety campaign messaging provides safety notices.

Korea realized that the CBS was an effective tool that could help disaster response authorities avoid missing out on the 'golden time' during natural and manmade disasters, including the Gyeongju earthquake (on September 12, 2016) and Gangneung forest fire (on May 6, 2017). There has been overwhelming demand for the CBS' SMS messaging across a range of disasters since then. This demonstrates that it is imperative to utilize the system more effectively.

Figure 2 The Sequence of Sending Phased Emergency Texts



Accordingly, metropolitan and local governments in Korea are equipped with a system that can send such messages to their residents without having to receive approval from the Ministry of the Interior and Safety(MOIS). They are able to make their own decisions and fast-track the processes for dealing with both local natural disasters and manmade disasters, such as wildfires, blackouts, and chemical leaks, which require urgent and precise on-site command. The speed of delivery has become incredibly fast by eliminating intermediate decision-making procedures. For national emergencies, responses to special weather reports, and information on civil defense situations, the MOIS sends the messages directly to citizens.

From December 2019, MOIS has been providing translated emergency disasters texts (in English and Chinese) transmitted from the central and local governments in cooperation with the Korea Tourism Organization, In addition, calls made by foreigners to the Korea Centers for Disease Control & Prevention(KCDC)'s 1339 hotline are transferred to the 1330 tourist call center to provide information and guidelines regarding COVID-19 in foreign languages.

Municipalities throughout Korea are putting every effort into curbing the contagion as they use the CBS to inform the public of the movement paths taken by confirmed patients and other related information. Residents who receive COVID-19 emergency texts can quickly check if they have been anywhere that overlaps with the movement of a confirmed patient, allowing them to get tested quickly if necessary. In this way, the CBS contributes to slowing the spread of the virus across the nation.

Picture 2 Poster on Social Distancing in Korea



Examples of Emergence Disaster Messaging (Source: article from the JoongAng Ilbo) (Seoul Municipality Office) Notice on prohibiting assemblies to curb the spread of COVID-19

Seoul Station Plaza ~ Seoul / Cheonggye / Gwanghwamun Plaza ~ Hyojadong Intersection /Sinmunro / Jongno 1-Ga /Gwanghwamun Plaza ~ Roads near the PM's official residence and its neighboring sidewalks Call #120

(Mapo-Gu Office) Please refrain from attending religious events, gatherings, or assemblies to prevent the spread of COVID-19 and maintain enhanced personal hygiene measures, such as wearing a mask and frequently washing your hands.

(Gyeonggi Provincial Office) Please refrain from attending religious events including church services, Buddhist or Catholic services, as well as a variety of other large gatherings (Call #031-120).

(Eunpyeong-Gu Office) The total number of confirmed patients stood at eight as of Saturday, February 29, 2020 (increase of 0 persons in the region). Please check related information on our website, Facebook page, and blog. Please follow the personal hygiene recommendations and refrain from attending religious events or services.

Emergency response systems of broadcasting/telecommunications/internet service providers

The Korean government inspected the emergency response systems of broadcasting/telecommunications/internet service providers in preparation for infections among network management and operation staff. Major telecommunications service providers have ensured that the movement paths of key facility management staff do not overlap to prevent the mass quarantine of staff at the same workplace in case infections occur. They created a team dedicated to telecommunications network operation, while also creating an emergency backup team in case of a workforce shortage due to infections among key personnel. If their buildings are shut down, network operations will be remotely carried out at separate network operations centers or other building nearby.

Although the overall network capacity is not experiencing a shortage according to traffic and capacity inspections, the government has ordered an increase in the number of lines in preparation for a sudden surge in traffic. To prepare for increasing calls for COVID-19 testing inquiries and TV home shopping, measures have been put in place to increase the call capacity of the KCDC hotline (1339) and home shopping channels.

2.2 Smart Working

A special website providing information of solution companies for remote working

As services not requiring in-person contact are on the rise due to COVID-19, solutions needed for remote working and remote learning will be provided. The Korean government opened a website to provide information about companies providing solutions for remote working and education and their products; related support will also be provided. The website was opened after a joint survey with the Korea Software Industry Association to identify business demand and classifying more than 140 solutions by sector. The website provides filtered search results of companies (company information, functions and price of their products, etc.), and users can visit the company website for more details. Information about free solutions is also available so that they can be utilized for remote learning and remote working.

Smart working and social distancing (Holding virtual video conferences)

A number of municipalities in Korea are performing their duties through ICT-enabled real-time virtual meetings instead of in-person meetings as part of their efforts to implement strict social distancing measures to slow the spread of new infections. Video conferencing can be a viable alternative to essential in-person meetings due to the coronavirus outbreak. It also helps to prevent the spread of the virus by eliminating the need for physical contact between the participants.

Picture 3 The Prime Minister Chung Sye-kyun holding a COVID-19 video conference (22 March, 2020)



Local governments' responses to the coronavirus outbreak through virtual video conferencing

Seocho-gu in Seoul City is holding its COVID-19 Disaster Safety Response Meeting via video conference call. Senior government officials and staff members attend the meeting from their offices instead of a designated conference room. All cadre meetings regarding COVID-19 quarantines and measures to revive the local economy were held via video conferencing in Gochang-gun, North Jeolla Province.

Meanwhile, Suwon City in Gyeonggi Province has been operating a "Public-Private Video Conferencing System" since March 26, which allows for safe and convenient communication via video calls when the city holds committee conferences and media briefings.

Participants can take part in such meetings online as long as they have devices that can be connected to the Internet. In particular, the system has been praised for its ability to share various documents and video clips during meetings as well as promoting the lively communication through real-time chats.

Remote work through the use of a Global Virtual Private Network (GVPN)

The Korean government has put stricter guidelines for work in place that mandate public officials to shift to remote work using Korea's ICT infrastructure for the purpose of stemming the coronavirus crisis. On March 12, the Ministry of Personnel Management (MPS) released the "Guidelines for Flexible Work Hours among Civil Servants to Tackle COVID-19." The key to these guidelines is that more than one third of the total number of employees in each department is required to work remotely on a rotating basis. Remote work includes working from home and working at smart work centers (which are located at other government complexes in close proximity to their homes or at a given government ministry building).

Civil servants use the GVPN and G-Drive when working remotely. GVPN is a system through which employees can log onto the government ministry's intranet even outside of their office. No matter where or when they work, employees can carry out administrative duties at home or other locations during business trips in Korea or abroad as long as they can use the internet and have access to the government intranet. G-Drive is a cloud storage system tailored to public officials working for central administrative agencies. It can store and manage work materials in the same format as those saved in office computers using a service similar to private cloud networks such as Google Drive. Using this kind of ICT infrastructure, Korean civil servants can perform work even outside of the workplace in working environments nearly equivalent to their offices.

The number of GVPN subscribers stood at 87,000 as of April 1, 2020, more than quadrupled from the figure at the end of the previous year. The level of user satisfaction level is also high. The vast majority of users responded positively to the change, citing a higher level of concentration on their work as well as the impact on slowing the transmission of the virus. Many predict that this could be the beginning of more widespread adoption of flexible working environments.

Cyber Security Guidelines for Staff Working Remotely

As remote working is on the rise, cybersecurity guidelines have been developed and distributed to reduce the risks of data breaches or ransomware through personal or public computers. Cybersecurity guidelines have been distributed to staff working from home, chief information security officers and managers of critical infrastructure.

※ The Korea Internet and Security Agency (KISA) created the COVID-19 Information Page to provide useful information about cybersecurity guidelines and recommendations and introduce useful COVID-19 apps.

The cybersecurity guidelines are as follows:

(For users) ❶ Ensure your computer is up to date ❷ Update your antivirus software and check your computer's security ❸ Set a password for your home router and update its software. Refrain from using private Wi-Fi or public computers ❹ Use work e-mail accounts rather than personal ones ❺ Refrain from visiting websites unnecessary for your work ❻ Be careful when downloading (Be aware of ransomware)

(For data security manager) ❶ Recommend that staff use VPN ❷ Develop cybersecurity guidelines for staff working from home and raise their awareness of cyber security issues ❸ Manage user accounts and the access level of staff working from home ❹ Automatically log out idle users ❺ Ensure strong monitoring of log-ins and VPN connections ❻ Improve cybersecurity for personal and company data

2.3 Remote Education

Providing educational contents by the central government

As schools have been shut down due to COVID-19, the Korean government is offering science content online to minimize interruptions in students' learning and expand their opportunities for learning activities. On March 9, the Korean government created a general information page on the science portal website, ScienceAll, to introduce diverse online science content, which contains educational content for science, mathematics and software; immersive content for learning science (AR, VR); video clips, comics and quizzes about science. The government also announced the launch of the page through a notification page for parents. After the information page was created, the number of users of ScienceAll increased by 1.04 compared to the week before and by 2.74 compared to January 2020, showing that more people are using the portal's content.

* (Average daily users) 11,001 (January 20) → 28,881 (Fourth week of March) → 30,092 (March 30 - April 5)

As many universities are switching to online classes, instructors are facing problems due to being unable to offer students hands-on experience. To tackle this challenge, the Korean government created and released hands-on learning content using simulation software for 23 high-demand classes in (e.g. quantum chemistry), in addition to currently available software and educational content. Using the online simulation platform, EDISON, students will be able to get hands-on experience through simulation and access diverse content including videos, text and data, which is expected to increase the effectiveness of online learning.

※ EDISON: Education-research Integration through Simulation on the Net

Zero-rating when accessing EBS (Korea Educational Broadcasting System) and educational websites

On March 16, the Korean government decided to apply zero-rating by exempting certain educational websites* from the data allowance until the end of May.

* Digital Textbook, Cyber Learning Space, ScienceAll, Entry (software), CareerNet

Starting from April 9, students, parents and teachers can access the EBS website free of data charges on their smartphones until the end of May, without having to apply for it.

* Zero-rating is applied only to the website of EBS; it is not applied when using EBS content on other websites such as YouTube or Naver TV.

IPTV and pay TV to provide real-time EBS educational content

Korea's pay TV providers, including the three major IPTV companies (KT, SKB, LGU+), cable TV and satellite TV, are providing real-time educational content such as EBS live lectures for primary and secondary school students on their channels.

Students with access to IPTV and other pay TV services can now enjoy EBS lectures at home on a platform of their choice (Internet or TV)

36,000 smart tablets donated to children in low-income families

In response to the shortage of smart tablets prepared by the Korean government for children in low-income families, Samsung Electronics will donate 30,000 tablets (Galaxy Tab A 8.0) in partnership with the Hope Bridge Association of the National Disaster Relief, and LG Electronics will donate 6,000 tablets (G Pad 3 8.0).

Seoul City Office of Education's efforts in remote education

The Seoul Metropolitan Office of Education (SMOE), which has the largest number of students and education-related stakeholders in Korea, has established an educational infrastructure with the view to implementing a stable system of remote education that will be introduced nationwide. The SMOE is taking a multifaceted approach to providing public schools with the support they need to cover the curriculum.

First, to provide support to students who find it difficult to access digital classes, the SMOE is operating a rental business that lends smart devices to students from low-income families to provide access to online education. Priority is granted to third graders at junior high and high schools from low-income families who do not own IT devices.

Furthermore, the SMOE offers wireless AP devices to all schools across districts and rents WiFi routers to all schools across the nation through the SchoolNet service so that teachers can effectively educate students via online classes. The SMOE will pay 30,000 won in telecom expenses for one month to teachers who participate in remote classes.

The SMOE has formulated and implemented the "Operational Plan for the Seoul Version of Online Classes," which is designed to close learning gaps caused by the closure of schools following the coronavirus outbreak and prepare students for remote learning. To begin, it set up on-site and remote education support groups under the plan. Training has been designed for teachers to take advantage of a range of online education platforms that can be used to run online classes. For aspiring schools and teachers, the SMOE has introduced services via online learning programs such as Edunet, EBS Online Class, and Google Classroom. It released and distributed an "Online Learning Management Manual" and used the Seoul Education YouTube channel to help teachers who encounter difficulties preparing for online classes.

2.4 Remote Medicare

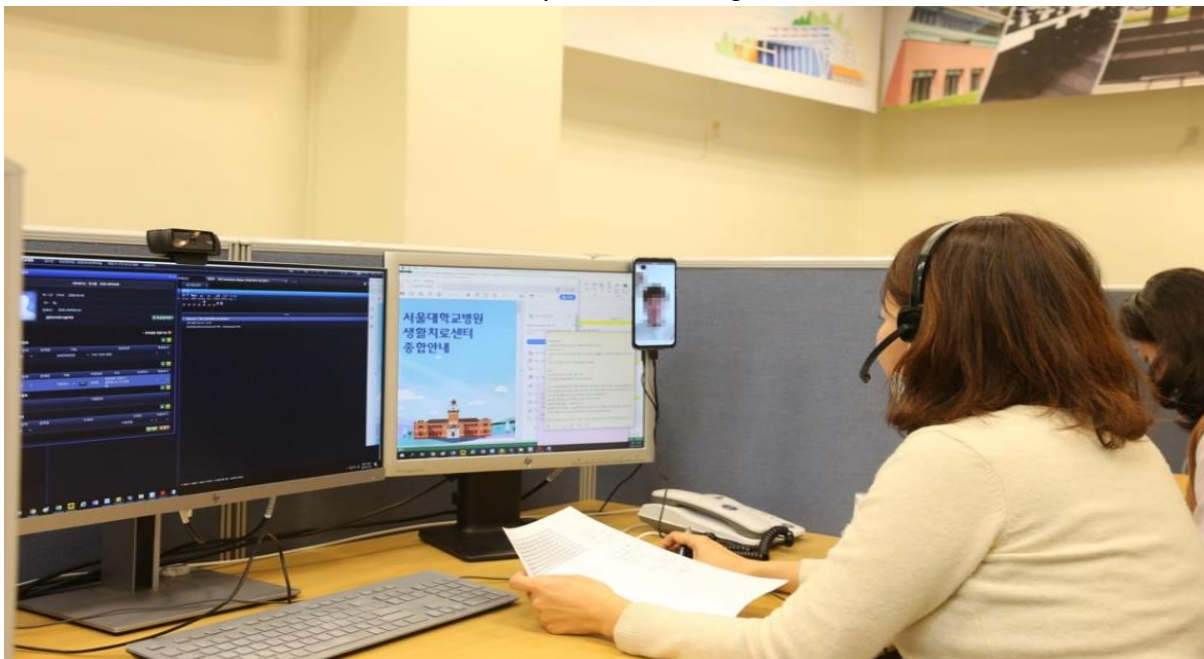
The Korean government has temporarily permitted doctors to perform telemedicine from the end of February as part of preventive measures to avoid group contagion in vulnerable facilities including medical institutions and nursing homes. In other words, patients can receive phone consultations and have medicine prescribed without visiting medical institutions when the doctor considers it safe.

Remote medicine targeting confirmed coronavirus patients

Last March, telemedicine services were implemented in Moongyeong Seoul National University Hospital (North Gyeongsangbuk-do Daegu 3 Living and Treatment Support Center) for the first time in Korea, as there were clusters of confirmed coronavirus patients in Daegu City, Gyeongsangbuk-d. The Moongyeong Seoul National University Hospital relies on video calls and electronic systems more safely and efficiently to monitor coronavirus patients hospitalized with mild symptoms.

Nurses ask patients detailed questions about their conditions via video calls through smart phones. The Moongyeong Seoul National University Hospital established the same computer network as its main hospital to record patients' medical examinations and treatments through telehealth video conferencing. Medical questionnaires filled out by patients and X-ray scans are uploaded onto the computer. Radiologists from Seoul National University Hospital, which is hundreds of kilometers away from Moongyeong see the video and enter the results into the computer database. Backed by these services, the hospital has been able to check the symptoms of confirmed patients in real time and transfer patients with aggravated symptoms to larger neighboring hospitals.

Picture 4 Remote Medicare services are provided during COVID-19 crisis



Telemedicine using apps

In these circumstances, several startups have begun to develop telemedicine service apps. Patients can log onto the Medihere app, select the hospital they want to visit, and make an appointment to see a doctor. They can receive remote medical advice via video call using the Telemedicine Treatment Room menu provided by the app. Prescriptions are sent to the pharmacy designated by the patient. Odoctor provides a service called Coronavirus 119 where self-reporting their symptoms allows patients to receive medical treatment and prescriptions.

The Coronavirus 119 app gives patients access to general diagnoses for a cough or cold alongside remote treatment and prescriptions for suspected coronavirus symptoms. If an app user is suspected of being infected with COVID-19, they will then be connected to the 1339 hotline. There, they can receive a diagnosis and receive a prescription from a doctor by phone after filling out a questionnaire that screens for symptoms.

If a pharmacy has been designated beforehand, the hospital sends the prescription to the pharmacy. Medicine can be delivered by proxy or directly to the patient. Although Easydoc is not an app for remote medicine, it was developed by currently practicing doctors and pharmacists to ask patients questions about their medical conditions. This app helps patients fill in medical questionnaires based on the format deployed by COVID-19 screening hospitals prior to their actual hospital visits. Since patients pay a visit to a clinic after filling out the forms, the app can shorten the time that patients spend at the clinic and ultimately reduce the risk of transmission within hospitals.

Telemedicine using apps leads patients to answer questions about their medical history through mobile devices. The services are highly convenient and efficient, while also preventing contagion that could occur during direct hospital visits.

2.5 Predictive Research on the Spread of COVID-19

The government is making full use of Korea's research capabilities to support the decision-making process of the infection control authorities, such as, sharing data, for accurate and reliable prediction of the spread of COVID-19. The Korean government is supporting predictive research on the spread of COVID-19 carried out by Korean researchers using diverse methods, by identifying and sharing data that can be used by researchers within the scope of data protection and also by helping researchers establish a professional network among them. Such support will be useful for forecasting the macroscopic spread of COVID-19 and the effectiveness of response measures, which will be helpful when making decisions needed for infection control.

By partnering with Korea's telecommunications company, KT Corporation, the government is providing researchers with data of the levels of foot traffic and international roaming, collected by KT, for free. This data has been available for studies to use for public purposes since April 1. The statistics from the KCDC on health and epidemiological data are also being provided to researchers conducting predictive research. To make full use of Korea's research capabilities for predicting the spread of COVID-19, the government is making efforts to establish a research network composed of relevant agencies and researchers to facilitate the sharing of data and research findings needed for COVID-19 spread forecasting.

2.6 Creating apps related to COVID-19

The development of coronavirus apps is ongoing in Korea. During the initial stages of the outbreak, a university student created the "Coronavirus Map" app which informs users of the movements of confirmed patients based on information released by the Korea Centers for Disease Control and Prevention (KCDC). Since, the virus has spread to dozens of areas across the nation and the outbreak has become prolonged, many startups have also developed apps, providing a wide range of information and functions.

The app "Now and Here" calculates a mix of risk factors in surrounding areas when users enter their commuting routes. Moreover, if users record their own routes, the app serves the function of comparing the user's paths with those previously taken by confirmed patients or new patients diagnosed with the coronavirus. If the user has been at the same place as a confirmed patient at a similar time, the app suggests when and where testing is available.

The app Cobaek (an alert for coronavirus within 100 meters) sends an alarm when users are within 100 meters of a place that a confirmed patient visited. With the alarm on, users are saved the hassle of checking the details of paths taken by confirmed patients. This convenient app has been downloaded hundreds of times. The app was then upgraded to the Cobaek Plus version with the addition of alerts for the availability of publicly provided masks at pharmacies.

Social service personnel from Gyeongsangnam-do produced an app tailored to the region that provides information on the movements of confirmed patients in the region. Using Google Maps, this app displays details on the movement and visits of infected citizens based on the user's location and a coronavirus patients' visits to different areas are clearly marked.

The app developers came to realize the inconvenience caused by having to check two apps to discover the paths taken by confirmed patients and locations selling publicly provided masks, despite increasing demand from residents for information on where masks could be purchased. Accordingly, residents can now receive updates on both through a single app.

The number of masks currently available at a given location is announced by color: green (more than 100), yellow (between 30 and 99), red (below 30), and grey (none available), and the information on mask sellers is automatically updated in accordance with the materials publicly released by the National Information Society Agency (NIA).

3. ICT locates COVID-19 with speedy TESTS



3. ICT locates COVID-19 with speedy TESTS

3.1 Developing the test-kit

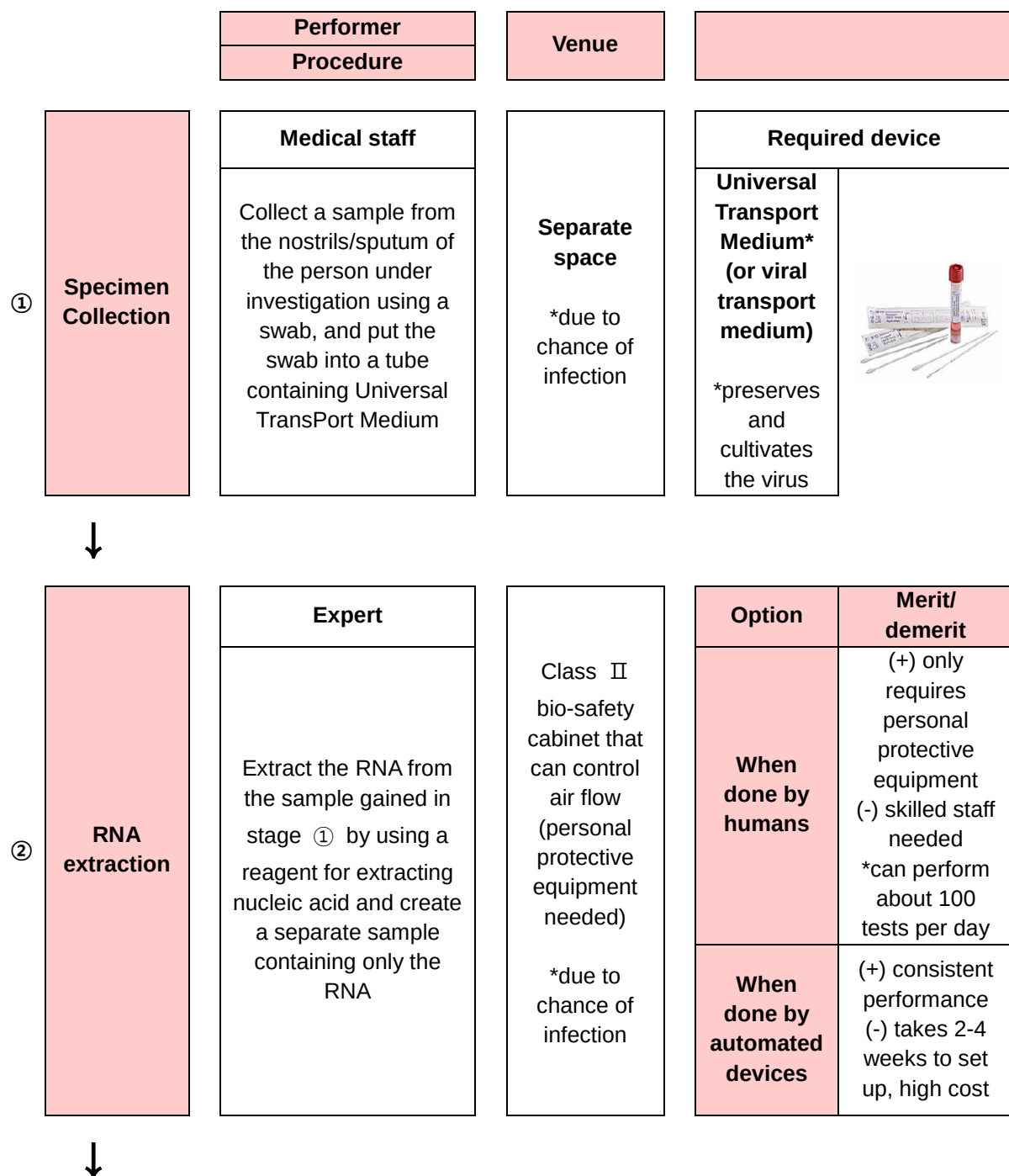
A COVID-19 diagnostic kit was developed by a Korean biotech company using ICT, AI and high-performance computing technology. It quickly became widely available and played a major role in eliminating uncertainties in the early stages of the viral spread. In Korea, five diagnostic reagent companies (Companies KogeneBiotech, Seegene, Solgent, SD Bio-sensor, and Biosewoom) have obtained emergency use approval as of now and are producing RT-PCR reagents, which are the chemical substance used in COVID-19 testing.

KogeneBiotech swiftly developed its product and became the first company to obtain approval on February 4, only about three weeks after the release of the COVID-19 genetic sequence on January 12. This was possible thanks to the companies that promptly started product development and the “emergency use approval” system, which enables swift approval of diagnostic reagents in a simplified process.

Diagnostic companies that acquired technological capabilities through infectious disease R&D have also contributed to such swift product development. Three out of total five companies that obtained emergency use approval received investment for R&D on infectious disease by the government. KogeneBiotech received R&D funding through the project on the “development of diagnostic technologies for high-risk virus.” Solgent and SD Bio-sensor developed diagnostic technologies via the project on the “development of PCR diagnostic kit for Zika virus.”

One of the reasons behind Korea’s rapid development of diagnostic kits is because companies invest in fostering an R&D environment based on ICT such as big data and AI, which allowed the use of research resources available on global online platforms of the WHO and other international organizations. Seegene uses high-performance computing and AI algorithms to dramatically shorten the process of developing a virus diagnostic kit from several months of expert dedication to around two weeks. The COVID-19 diagnostic kit developed using AI obtained a European certification (CE-IVD) (February 7, 2020), proving its excellence, and the Korean government has quickly approved emergency use of the diagnostic kit (February 12, 2020). In the wake of COVID-19, it became widely accepted that it is important to supply sufficient diagnostic tools early in the initial stages of the spread of infectious diseases.

Figure 3 COVID-19 Testing Method (RT-PCR)



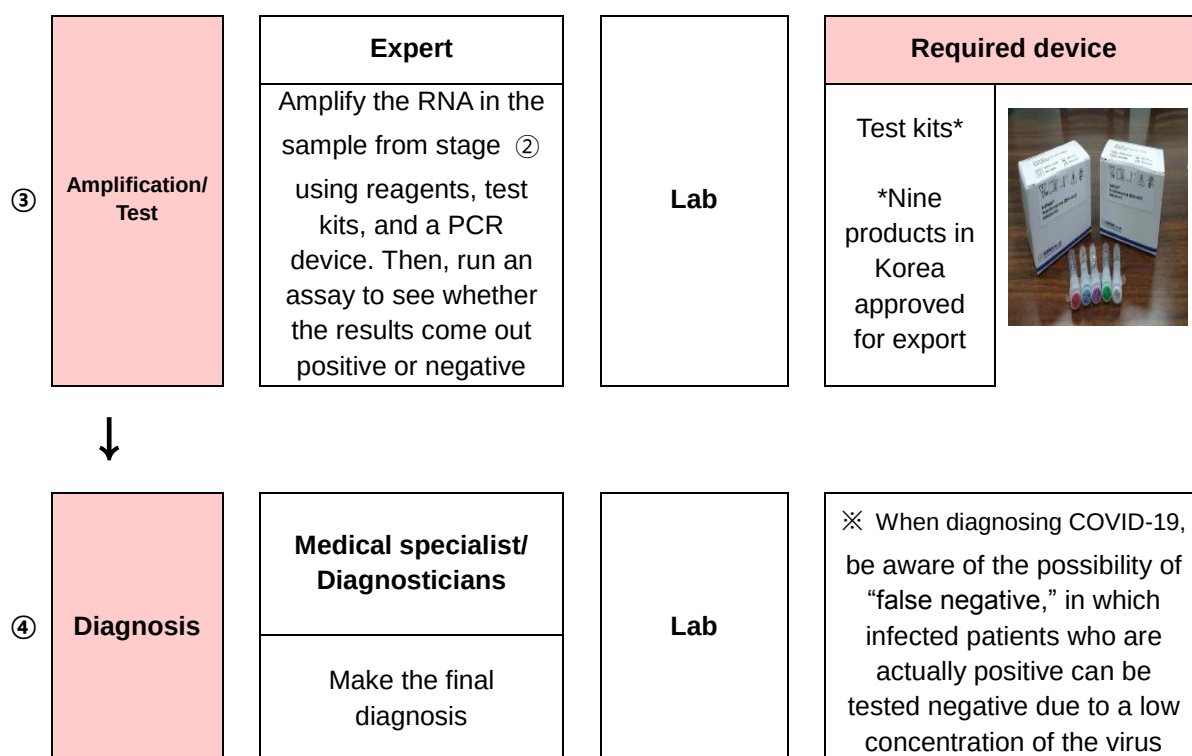


Table 1 Companies that obtained emergency use approval

Company (Date of Approval for Emergency Use)	Company Information
KogeneBiotech (Feb.4)	- Established in Mar. 2000 / SME - (Business area) Diagnostic reagent development and genome analysis service
Seegene (Feb.12)	- Established in Sep. 2000/ SME (listed on KOSDAQ market) - (Business area) Development of diagnostic reagents and automated software
Solgent (Feb.27)	- Established in Aug. 2000 / SME - (Business area) Diagnostic reagent development and genome analysis service
SD Bio-sensor (Feb.27)	- Established in Dec. 2010 / SME - (Business area) Development of diagnostic reagents and in vitro diagnosis system
Biosewoom (Mar.13)	- Established in Sep. 1997 / SME - (Business area) Development of clinical diagnostic drugs including diagnostic reagents

3.2 AI based patient examination

AI can quickly learn, recognize, and analyze large-scale data based on high-performance computing resources, enabling more accurate analysis and decision-making. Given its unique features of speed and accuracy, AI can play a significant role in supporting researchers and healthcare professionals in the diagnosis and screening of patients with severe symptoms, as well as developing appropriate responses based on a thorough analysis of the situation on the COVID19 spread. Korea's AI-based medical image analysis specialists, Companies Vuno, Lunit and JLK Inspection, train their AI algorithms with large-scale chest X-ray photographic data, and detect abnormal findings such as pneumonia – a major symptom of COVID-19 patients – with high accuracy in just a few seconds.

An AI that can read X-ray imaging of patients with lung conditions and identify those requiring intensive care in just 3 seconds has been installed by Vuno in a public health clinic in Hongcheon (February 2020). This AI is also being utilized in some of the hospitals in Daegu. JLK Inspection used an AI that reads X-ray images to check in just a few seconds whether the COVID-19 patients have other lung conditions (February 2020). The additional installation of these AIs is being discussed at the moment.

AI for medical imaging analysis is processed on a small device that can be attached and connected to portable X-ray equipment, in COVID-19 screening centers or ambulances. In a short time, it analyzes the lung images of severe COVID-19 cases with lung diseases, reporting the results shortly to healthcare professionals to assist them with diagnosis. In some regions, even with X-ray equipment, there are not enough healthcare workers to perform diagnostic tests. Also, hospital beds are limited against the large number of patients, so it is important to quickly screen patients and firstly accommodate patients with severe symptoms.

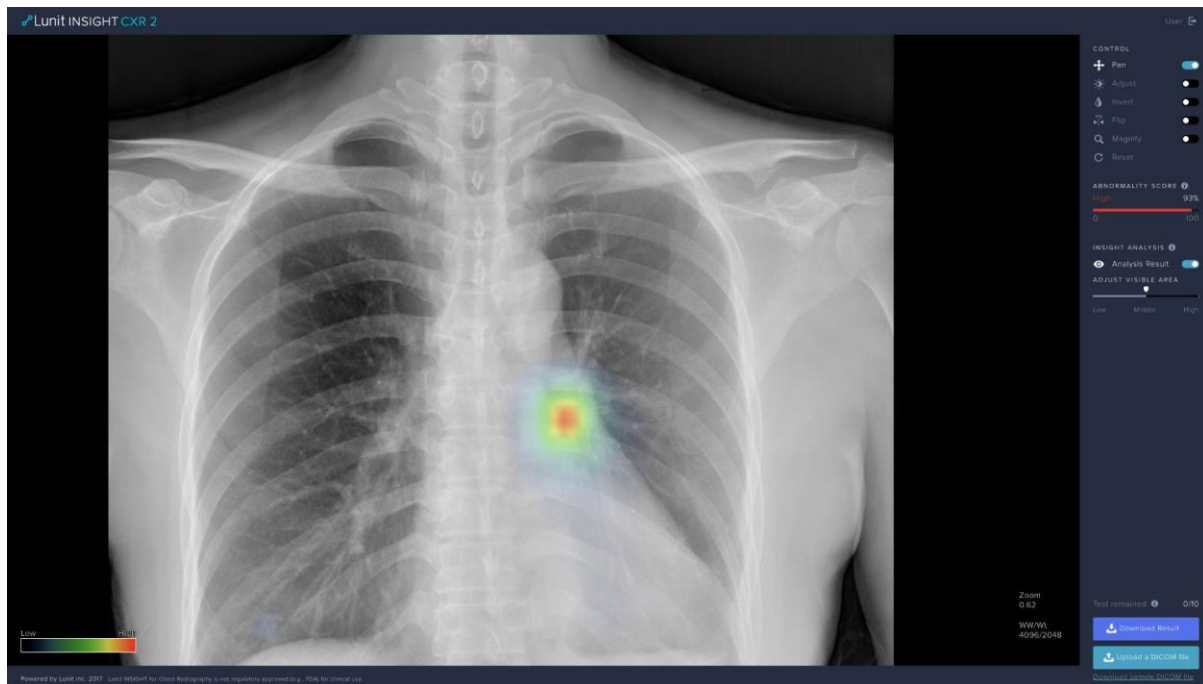
Some local governments of Korea, including Daegu Metropolitan City, Gyeonggi Province, Hongcheon County, and Gangwon Province, installed AI devices at medical sites such as public health centers and local hospitals to relieve the burden of healthcare workers and improve the efficiency of diagnosis. In addition, Lunit's AI-based medical devices are used at Prevent Senior, a large hospital in Brazil, to screen chest X-ray images prior to a doctor's reading to maximize efficiency.

The Korean government has spared no policy support to back these innovative AI-based responses of the private sector. First of all, the Korean government announced fast-track support measures for companies responding to COVID-19 (March 12, 2020). Existing high-performance computing support has been expanded and offered preferentially to organizations and businesses that develop AI algorithms or solutions related to COVID-19 response. A separate track of data voucher support project for COVID-19 response has been newly established and the target has been expanded from businesses to universities and research institutes. In addition, in order to encourage creativity of the private sector in effectively responding to similar crises in the future, the Korean government will continue to implement the National Strategy for AI announced in December 2019 to establish a preemptive and sufficient support system for the use of AI and data in the private sector. The Korean government strives to supply AI algorithms and customized data reflecting private

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demand, build large-scale high-performance computing infrastructure to facilitate data use, and provide comprehensive support to the private sector through an open platform (AI Hub). Moreover, by revising the law on data use, the Korean government aims to assist the private sector in achieving economic and social innovation by collecting, processing, and using large-scale data needed in fields such as healthcare.

Picture 5 Product by Lunit using deep learning technology to perform chest X-ray

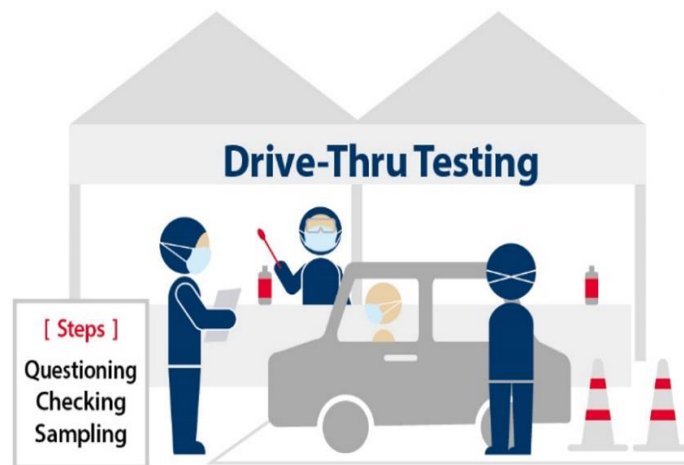


3.3 Walk-thru testing

K-Walk-Thru is a collective name for testing facilities adopted by Korea for the first time in the world to quickly and safely collect samples for COVID-19. A walk-thru testing station allows quick collection of samples as subjects walk through the station with minimal contact.

Having learned from the 2015 outbreak of the Middle East Respiratory Syndrome (MERS), Korea has remained vigilant and continued to refine its response system to better address potential outbreaks of large-scale epidemics, supporting hospitals to set up negative pressure rooms in 2018. The swift actions Korea has lately taken against COVID-19, including its innovative 'drive-thru' testing stations that help minimize the risk of cross infections at the testing centers while maximizing daily testing capacity amid fast rates of new cases, have received international attention and commendations.

Figure 4 Drive-thru Testing Centers

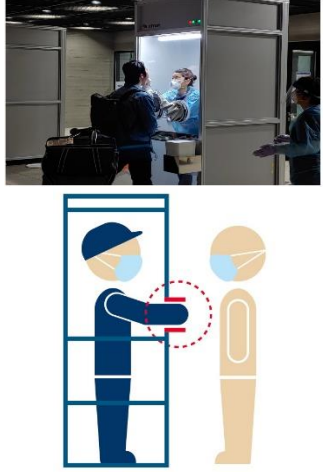


Korea took another step forward with its testing strategy and methods. It has recently adopted a 'Walk-thru' testing method which requires even smaller area for testing booths and shorter time to get tested. This walk-thru testing is now expected to become another exemplary model in terms of quick and effective measures against the new coronavirus.

The quick and safe K-Walk-Thru testing station is available in two different types: negative pressure type and positive pressure type. They both consist of a single booth that separates healthcare professional from patients being tested. The only difference is in terms of who is inside the booth and how much time it takes for each sampling.

In a negative pressure type booth, patients go inside while healthcare professionals stay outside. This requires time to clean the insides of the booth after each sampling. On the other hand, in a positive pressure type booth, healthcare professionals are the ones inside the booth, which saves time as only the sampling gloves exposed to the outside need to be cleaned after each sampling. A combination of the two types can be used depending on the situation.

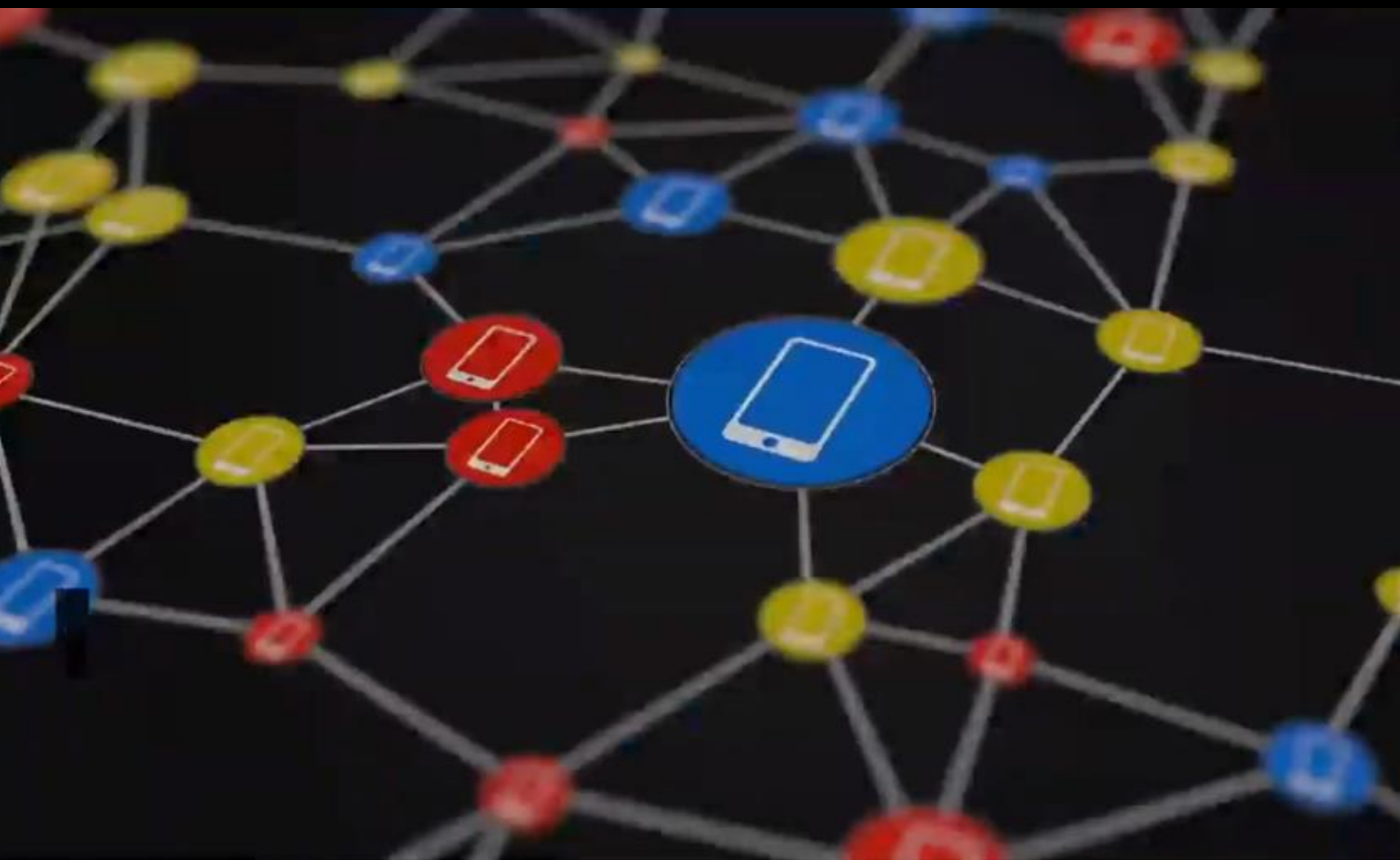
Table 2 Types of Walk Thru

Types	① Negative pressure booth (Booth for patients)	② Positive pressure booth (Booth for medics)
Details	Patients inside, Medics outside 	Patients outside, Medics inside 
Note	Booths need to be sterilized after each use. Medics outside the booth must wear protective gears. Takes 10 mins for each sampling due to cleaning & sterilizing of the booth inside.	Only the gloves used outside the booth need to be cleaned & sterilized. Medics inside do not necessarily have to wear protective gears. Takes 1 min for each sampling.

Picture 6 Commissioner of Korean Intellectual Property Office, Park Wonjoo Meeting with the Walk-Thru Booth Inventor (6 April, 2020)



4. ICT & TRACING COVID-19



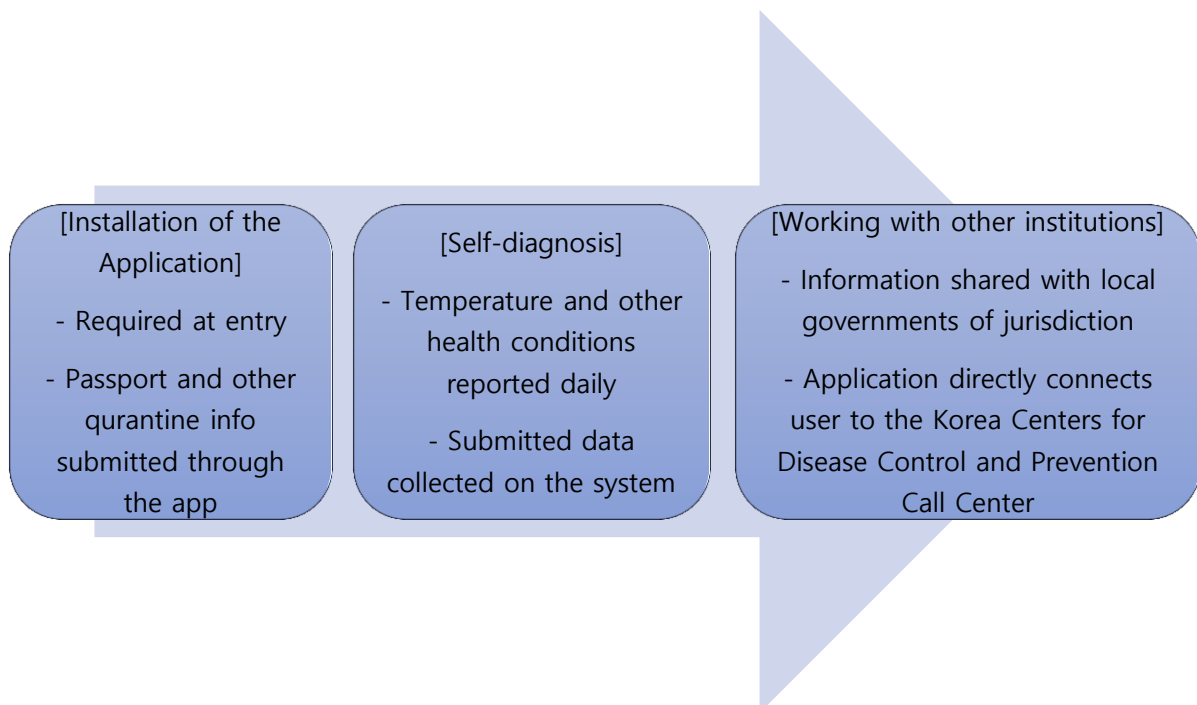
4. ICT & Tracing COVID-19

4.1 Self-diagnosis APP

The Korean government has also utilized ICT in preventing the spread of COVID-19 via travelers entering the country. An example of this is the self-diagnosis mobile application developed by the government to monitor symptoms of inbound travelers while also providing them prompt medical advice. The mobile application connects the user directly to the call center and social media channels in order to provide medical answers against suspected symptoms and allow early treatment. First, travelers from China under the special immigration procedures since February 12, and then all inbound travelers since April 1 have been required to install the application at entry. As of April 9, the application has been installed by approximately 170,000 travelers with appropriate action taken for near 9,000 of them with possible symptoms.

The application can be downloaded through the URL and QR codes available around the airport or harbor immigration gates and on the special arrival cards. The application must be installed and used to submit passport information, nationality, name, address and other necessary information for quarantine. All inbound travelers must also report their health condition (body temperature, cough, sore throat, or difficulty breathing) through the application once a day during their 14 days of quarantine. The submitted data are collected on the self-diagnosis mobile system and checked against immigration data before being sent to the public health clinics under jurisdiction of local governments.

Figure 5 Process of Self-diagnosis APP



Travelers showing symptoms are encouraged to seek medical advice through call centers operated by the Korea Centers for Disease Control and Prevention (KCDC), or at COVID-19 screening centers. The information of those reporting symptoms for more than 2 days is transferred to local governments of jurisdiction so that the corresponding public health clinics can provide medical advice, testing and instructions on how to receive care. Local governments also directly check that those reporting symptoms for more than 2 days are tested.

An inbound traveler who does not install the mobile application or fails to submit their daily health conditions will be tracked through the self-diagnosis mobile system, which receives the actual immigration and visa information from the Korean government as well as airline and passenger data. If a traveler fails to use the application as advised, a notification and warning text messages are sent to the traveler on the first and second days, respectively. On the third day the traveler fails to use the application, the traveler is contacted via phone and instructed to install and use the application. If the traveler still does not comply on the fourth day, the traveler is notified to the police force to be tracked down.

This application is evaluated to be effective in not only for preventing further spread of COVID-19 but also for providing user-friendly services. The 4 self-diagnostic questions are presented on one page as yes-or-no questions, and it is easy to submit the answers. After the 14-day quarantine, an automatic message notifies the user to delete the application to avoid confusion.

Picture 7 Minister of Interior and Safety, Chin Young, at Incheon International Airport(6 April, 2020)

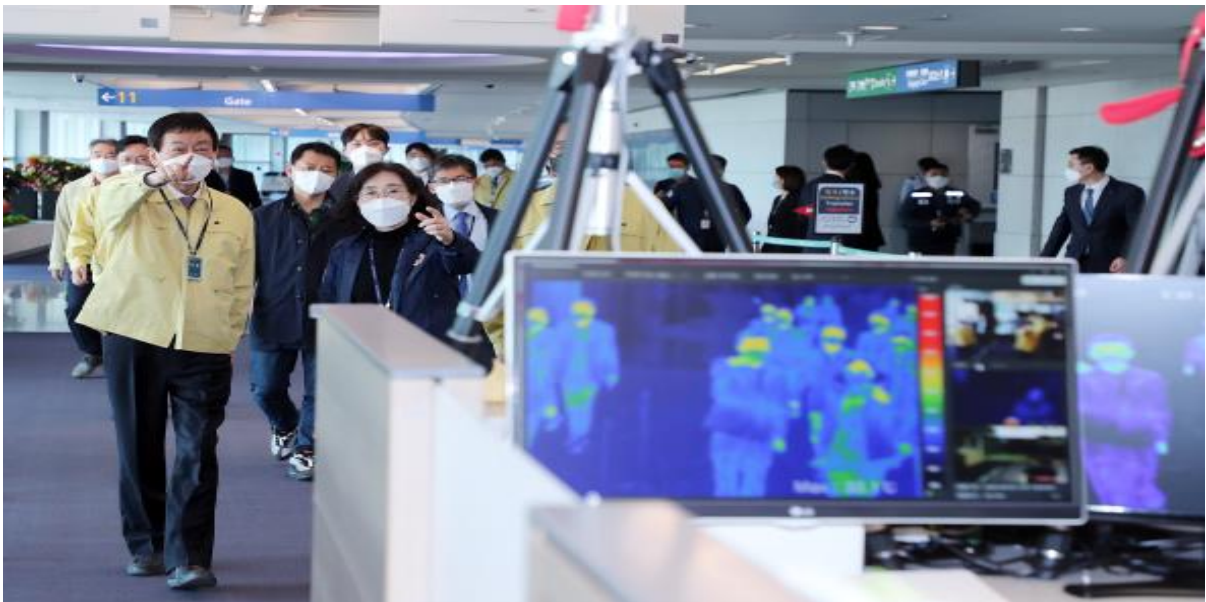


Figure 6 Self-diagnosis APP

Start to Mobile app	Proceed with special quarantine form	Proceed with daily Self Health Check	Check screening clinics

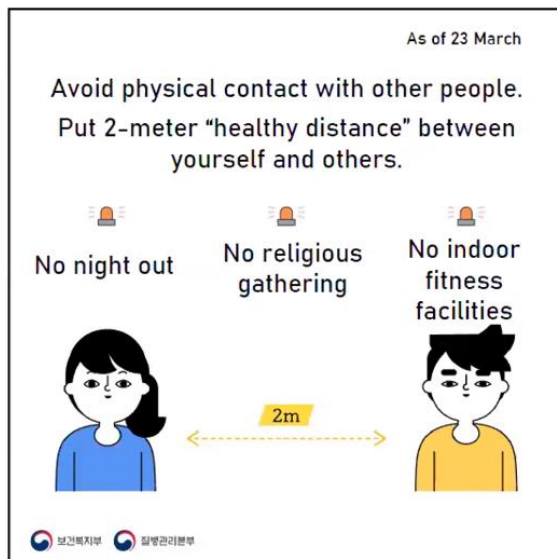


Figure 7 Self-diagnosis APP

언어를 선택하세요.
请选择语言。
Please select a language.
言語を選択してください。
Veuillez sélectionner une langue.

한국어

中文

ENGLISH
(日本)

FRENCH

← Special Quarantine Declaration

* Passport No. (パスポート番号)
Please Enter Your Passport Number.

* Please select the Region you have visited or actually lived in the last 14 days.
(最近14日以内に訪問したり、実際の居住地域を選択してください。)

Select (国番号選択)

* Phone Number (携帯電話番号)
PHONE NUMBER VERIFICATION
(携帯電話番号認証)

Emergency Contact in Korea
(韓国で連絡可能な知人の電話番号)
Please input numbers only, except a hyphen.

Name of School in Korea (韓国内の学校名)
Please enter the name of the school.

* I agree with the collection and use of my personal information including health information in accordance with Article 23 of the Personal Information Protection Act and location information in accordance with Article 15 of the Act on the Protection, Use, etc. of Location Information to prevent infection and transmission of an infectious disease in accordance with Article 15 and Article 17 of the Quarantine Act and Article 49 and Article 76-2 of the Infectious Disease Control and Prevention Act. ☐

[感染症]第15条、第17条及び[感染症予防法]第49条、第76条の2による感染症の予防及び感染の伝播の防止のため、[個人情報保護法]第23条の位置情報及び[位置情報の保護および利用に関する法律]第15条の位置情報が含まれた個人情報の提供及び活用に同意します。
More...(詳細を見る)

DONE (完了)

Phone number verification
(携帯電話番号認証)

Please enter the mobile number to verify.
(認証する携帯電話番号を入力してください。)

1. Please select a country code.
国コードを選択してください。

+82 REPUBLIC OF KOREA

2. Please enter your mobile number.
(本人の携帯電話番号を入力してください。)

Please input numbers only, except a hyphen.
(ハイフン以外の数字のみを入力してください。)

REQUEST CODE
(認証番号の要求)

3. Please enter the 6-digit verification number sent to your phone.
(携帯電話に送信された6桁の認証番号を入力してください。)

Certification Number
(認証番号)

DONE (完了)

CANCEL (キャンセル)

m2.bokjiro.go.kr

개인정보 수집, 이용 동의 내용
同意收集和使用个人信息内容
Consent to Collection and Use of Personal Information

질병관리본부는 신종코로나바이러스감염증에 대한 관리를 위해 아래와 같이 개인정보를 수집, 이용하고자 합니다.
 政府管理本部为了对新型冠状病毒感染症进行管理,将以下个人信息收集并使用。
 The Korea Centers for Disease Control and Prevention may collect and use personal information as stated below:

기본 개인정보 수집, 이용 내역
 基本个人信息收集内容
 Collection and Use of General Personal Identification Information

항목 Category	성명, 생년월일, 성별, 국적, 학교명(출신명), 주소, 휴대전화, 직함명, 학교명, 위치정보 姓名, 出生年月日, 性別, 国籍, 学校名称, 位置信息 Name, date of birth, gender, nationality, Right name, (vessel number), address, mobile phone number, company or school name, location information
수집목적 Collection Purpose	신종코로나바이러스감염증 및 新型コロナウイルス感染症 Novel Coronavirus (2019-nCoV) response
보유기간 Period of retention and use	신종코로나바이러스감염증 해소 후 2개월 至新型冠状病毒感染症确诊解除两个月以后为止 The collected information will be retained and used until two months after the end of the 2019-nCoV transmission.

☐ 위의 개인정보 수집, 이용에 대한 동의를 거부할 권리가 있습니다. 그러나 동의 거부할 경우 입국 시 제약을 받을 수 있습니다.
☐ 你有权拒绝个人信息的收集和使用, 但如拒绝, 入境可能会受到限制。
☐ You may choose to refuse collection and use of your personal information, but you may be denied entry by doing so.

<각각> 제15조, 제17조 및 <감염병예방법> 제49조, 제76조의 2에 따른 감염병 예방 및 관리에 관한 법률에 의해 <개인정보보호법> 제23조의 건강정보 및 <위치정보의 보호 및 이용 등에 관한 법률> 제15조의 위치정보가 포함된 개인정보의 제공 및 활용에 동의합니다.
 根据《感染症法》第15条、第17条、以及《传染病预防法》第49条、第76条第二项、为预防传染病与阻断疫情传播, 本人同意向相关管理部门提供并同意使用《个人信息保护法》第23条健康信息, 以及《位置信息保护和利用等相关法律》第15条位置信息个人信息。

I agree with the collection and use of my personal information including health information in accordance with Article 23 of the Personal Information Protection Act and location information in accordance with Article 15 of the Act on the Protection, Use, etc. of Location Information to prevent infection and transmission of an infectious disease in accordance with Article 15 and Article 17 of the Quarantine Act and Article 49 and Article 76-2 of the Infectious Disease Control and Prevention Act.

Daily Self-diagnosis

Choose the symptoms you have today
(今日の症状を選択してください)

No symptoms (無症状) ☐

Fever - above 37.5 degrees (または熱が私は感じ)
YES (はい) NO (いいえ)

Cough (せき)
YES (はい) NO (いいえ)

Sore Throat (のどの痛み)
YES (はい) NO (いいえ)

Dyspnea (呼吸困難(息切れ))
YES (はい) NO (いいえ)

SUBMIT (提出)

Flattening the curve on COVID-19 : The Korean Experience

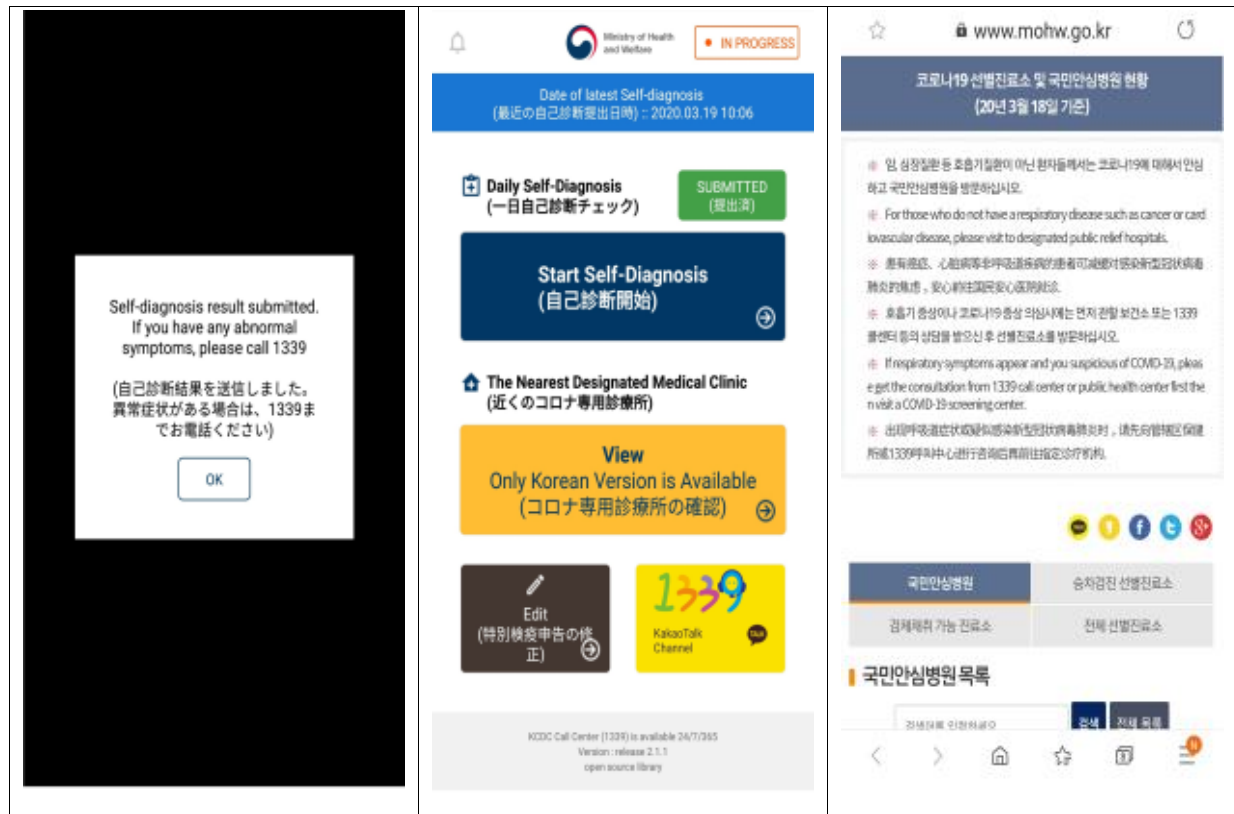


Figure 8 Process of Self-diagnosis

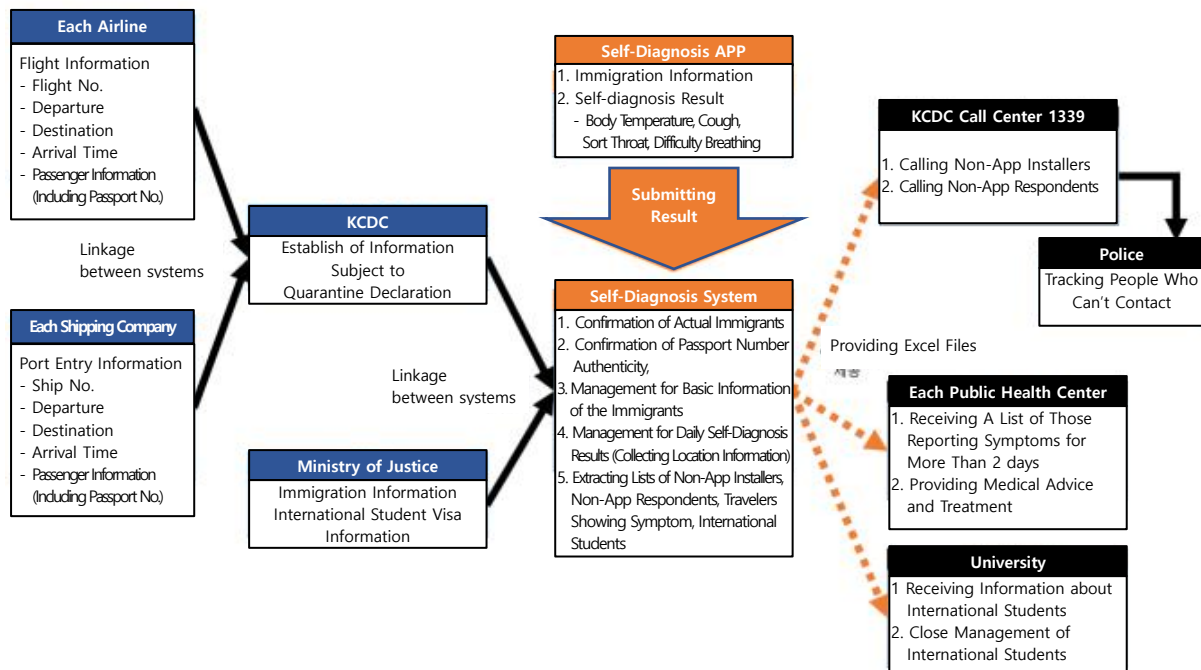
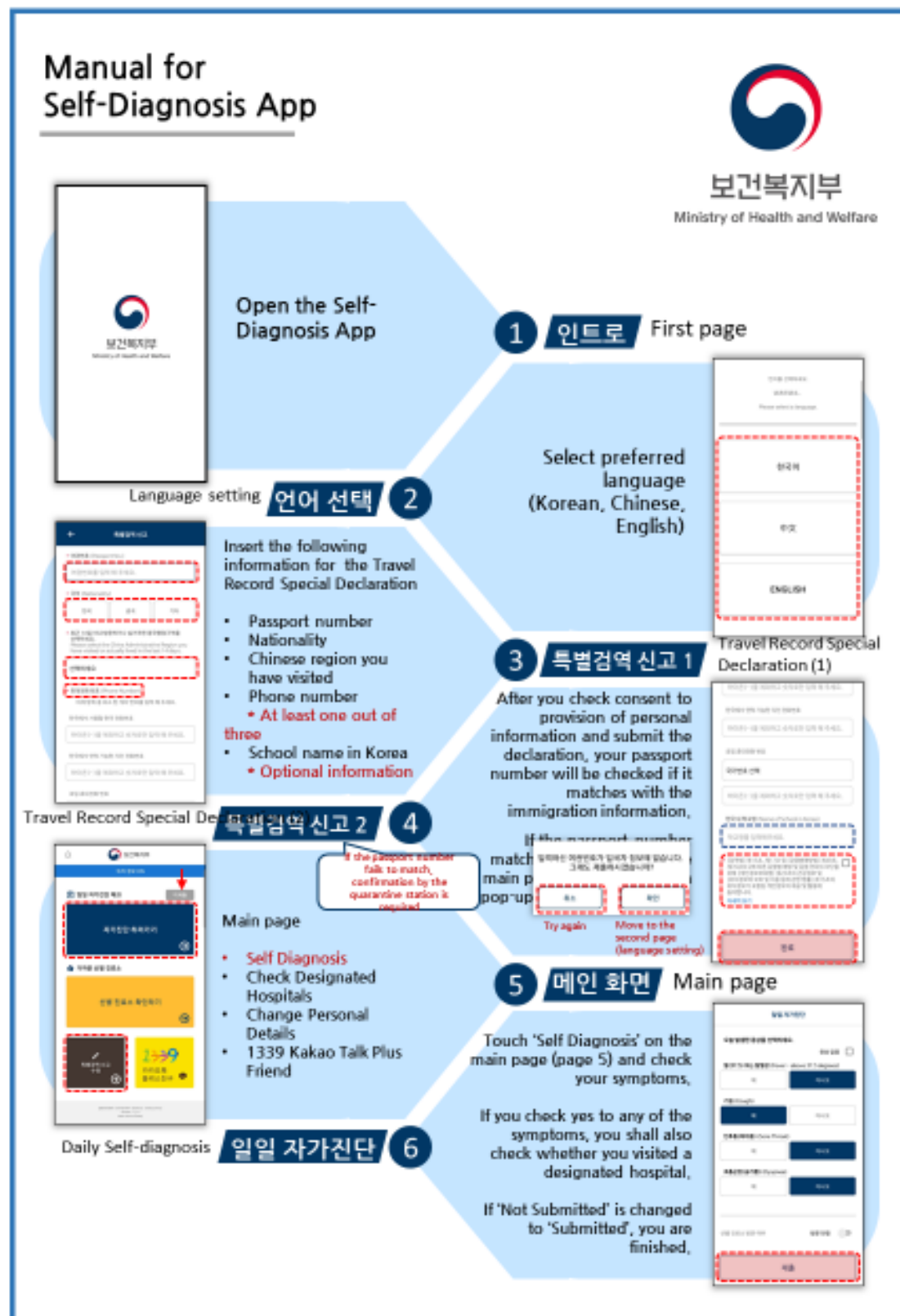


Figure 9 Manual for Self-Diagnosis App



4.2 Self-quarantine Safety APP

The Korean government has developed the Self-quarantine Safety Application to effectively support the monitoring of those under self-quarantine. The application has become available for download on Android and iOS since March 7 and 14, respectively. The application supports 3 languages (Korean, English and Chinese) and requires users to provide location and other personal information.

The application allows the users to monitor their conditions and conduct self-diagnosis, and ensures that the self-quarantine orders are kept by setting off an alarm when a user ventures out from the designated quarantine area. Installation of the application is voluntary for those living in Korea, which means that the user voluntarily downloads the application and give consent to providing location data and personal information. However, with an increasing number of inbound cases, as of April 1, all inbound travelers including the Korean nationals must download the app to enter Korea. Phone call services are also provided to those without a smartphone or those having trouble using the application. As of April 13, about 91.4% of those under self-quarantine have installed the application.

The application largely has 3 key functions: a self-diagnosis for the users to conduct and submit the results with the assigned government officers; a GPS-based location tracking to prevent possible violation of self-quarantine orders; and providing necessary information including self-quarantine guidelines and the contact info of the assigned government case officers.

Two types of the application were developed: one for the users under self-quarantine and the other for the assigned government case officers. Those under self-quarantine use the application twice a day to monitor oneself concentrating on four symptoms: fever, cough, sore throat, and respiratory difficulties. Once submitted, the self-diagnostic data will automatically be shared with an assigned case officer, who will be notified if the user does not submit the self-diagnostic data or becomes symptomatic. The case officer is also notified when quarantine is disobeyed, in which cases, the case officer takes appropriate measures to have the subject return to the quarantine area.

The application has been effective in monitoring those under self-quarantine and making sure that they stay in designated locations. The alarm function of the application, in particular, has been evaluated to encourage the quarantined to follow regulations. For example, only 3 to 4 subjects left the designated location each day from March 13 to 19. In all these cases, the case officers were able to persuade the subjects to return to their quarantine location.

Figure 10 Process of Using Self-Quarantine Safety APP

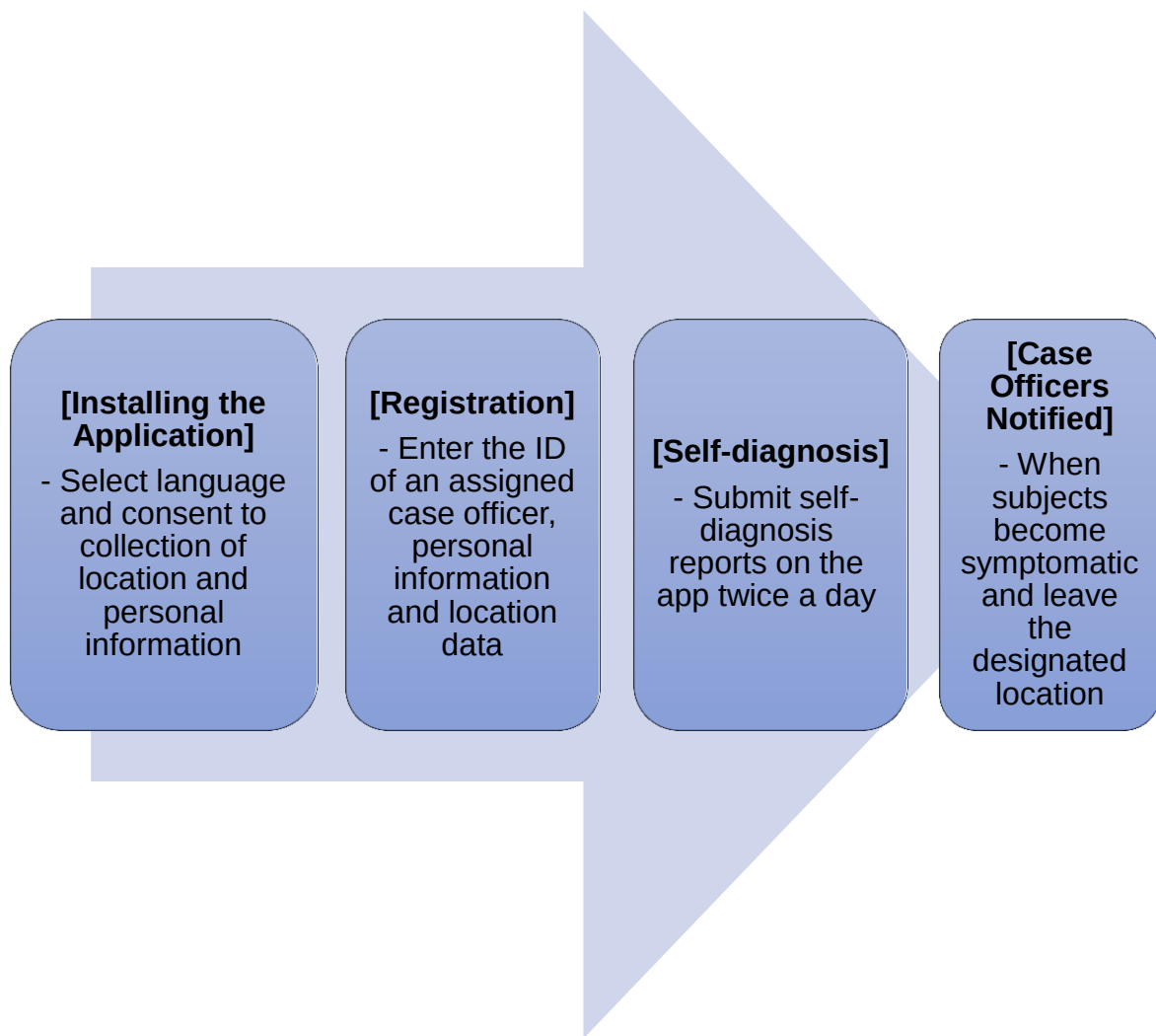


Figure 11 Self-quarantine Safety APP for Self-quarantined Subjects

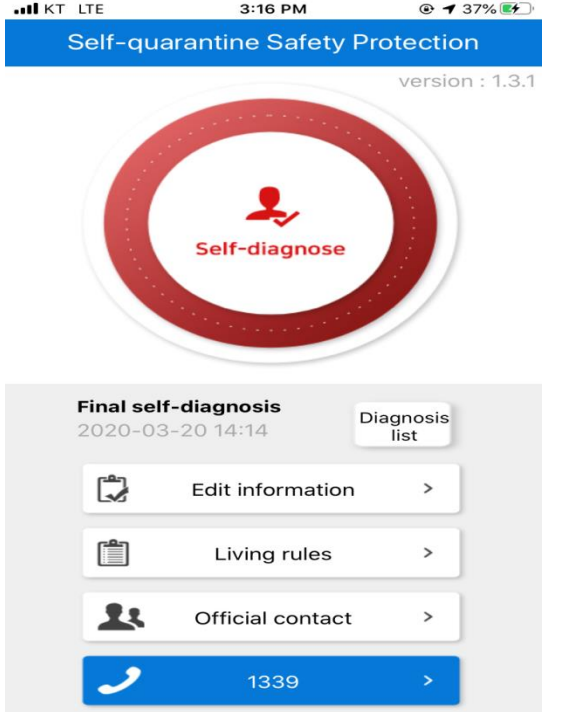
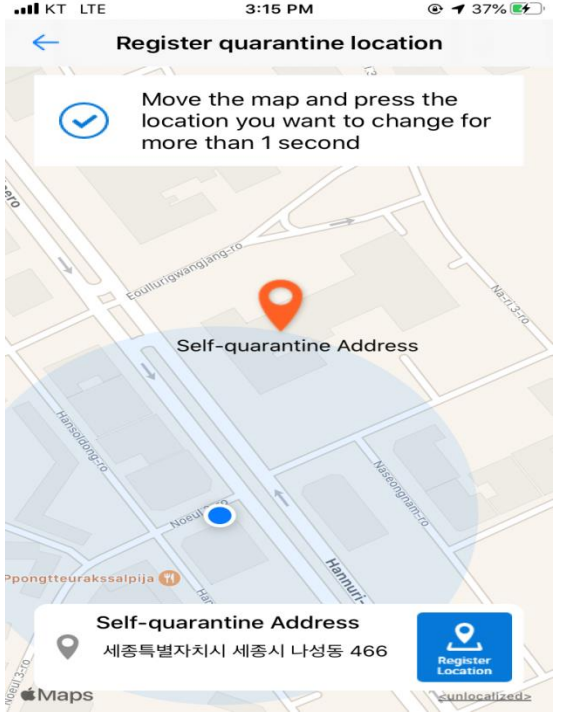
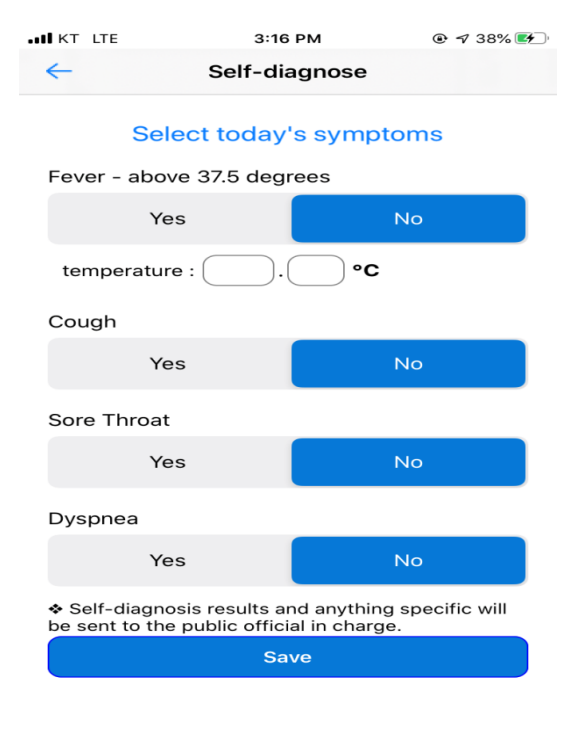
Start page	Register quarantine location
 Self-quarantine Safety Protection version : 1.3.1 Self-diagnose Final self-diagnosis 2020-03-20 14:14 Diagnosis list Edit information > Living rules > Official contact > 1339 >	 Register quarantine location Move the map and press the location you want to change for more than 1 second Self-quarantine Address 세종특별자치시 세종시 나성동 466 Register Location
Self-Diagnosis	Self-quarantine Guidelines
 Self-diagnose Select today's symptoms Fever - above 37.5 degrees Yes No temperature : . °C Cough Yes No Sore Throat Yes No Dyspnea Yes No ❖ Self-diagnosis results and anything specific will be sent to the public official in charge. Save	 자가격리대상자 생활수칙 감염 전파 방지를 위해 격리장소 외에 외출 금지 독립된 공간에서 혼자 생활하기 진료 등 외출이 불가피할 경우 반드시 관할 보건소(담당공무원)에 먼저 연락하기 가족 또는 동거인과 대화 등 접촉하지 않기 개인물품(개인용 수건, 식기류, 휴대전화 등) 사용하기 건강수칙 지키기 농특감시 기간 동안 관할 보건소(담당공무원)가 연락하여 증상 등을 확인할 예정입니다. 확진자와 접촉 후 14일이 경과하는 날까지 자가 모니터링하여 주시기 바랍니다. 자가모니터링 방법 호흡기증상 등 감염 증상이 나타나지 않도록 건강상태 확인 매일 아침, 저녁으로 체온 측정하기 보건소(담당공무원)에서 1일 1회 이상 연락 시, 감염 증상 알려주기 코로나바이러스감염증-19 주요 증상 발열(37.5°C 이상) 호흡기증상(기침, 인후통 등) 폐렴

Figure 12 Self-quarantine Safety APP for Assigned Case Officers

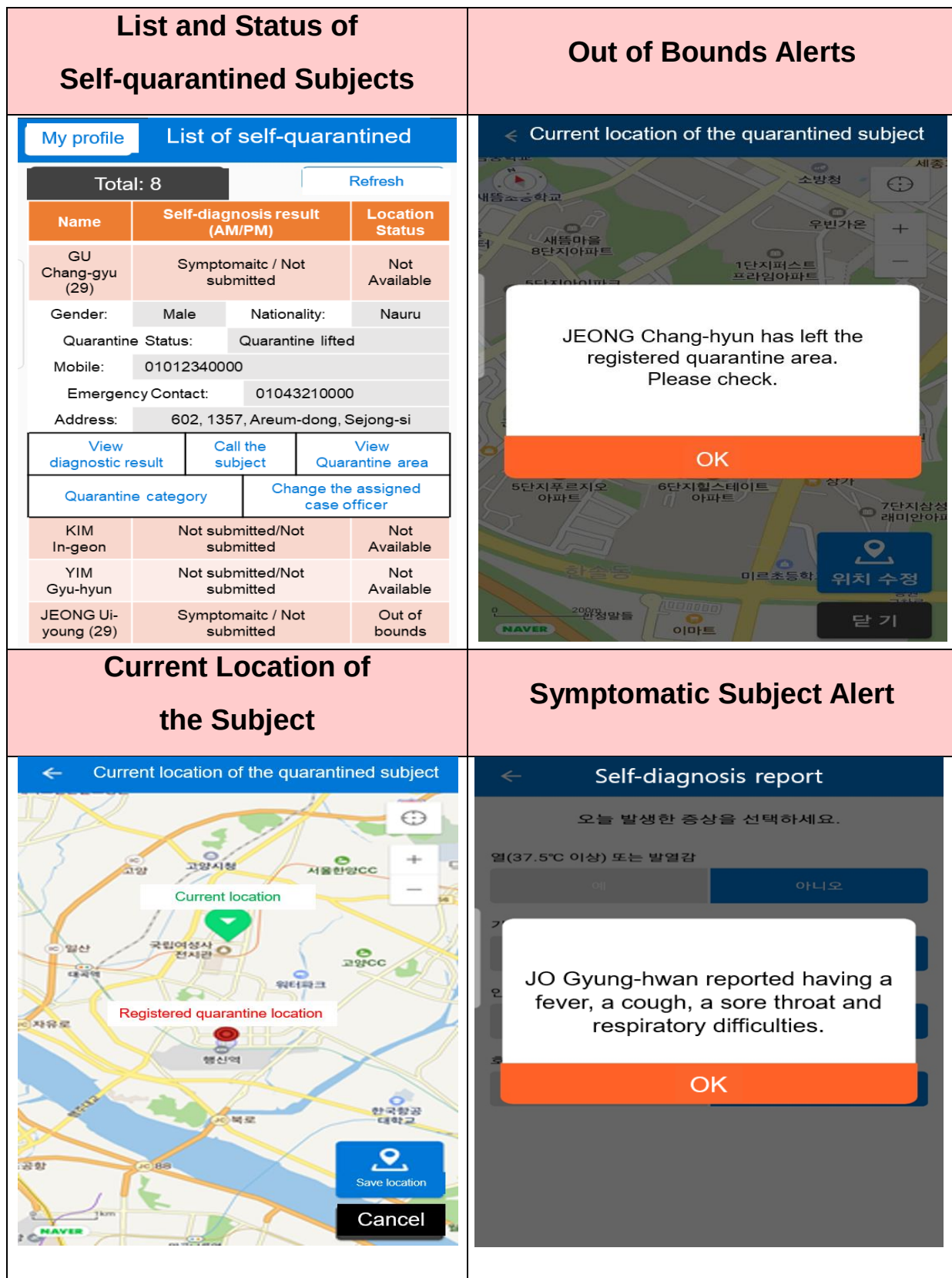
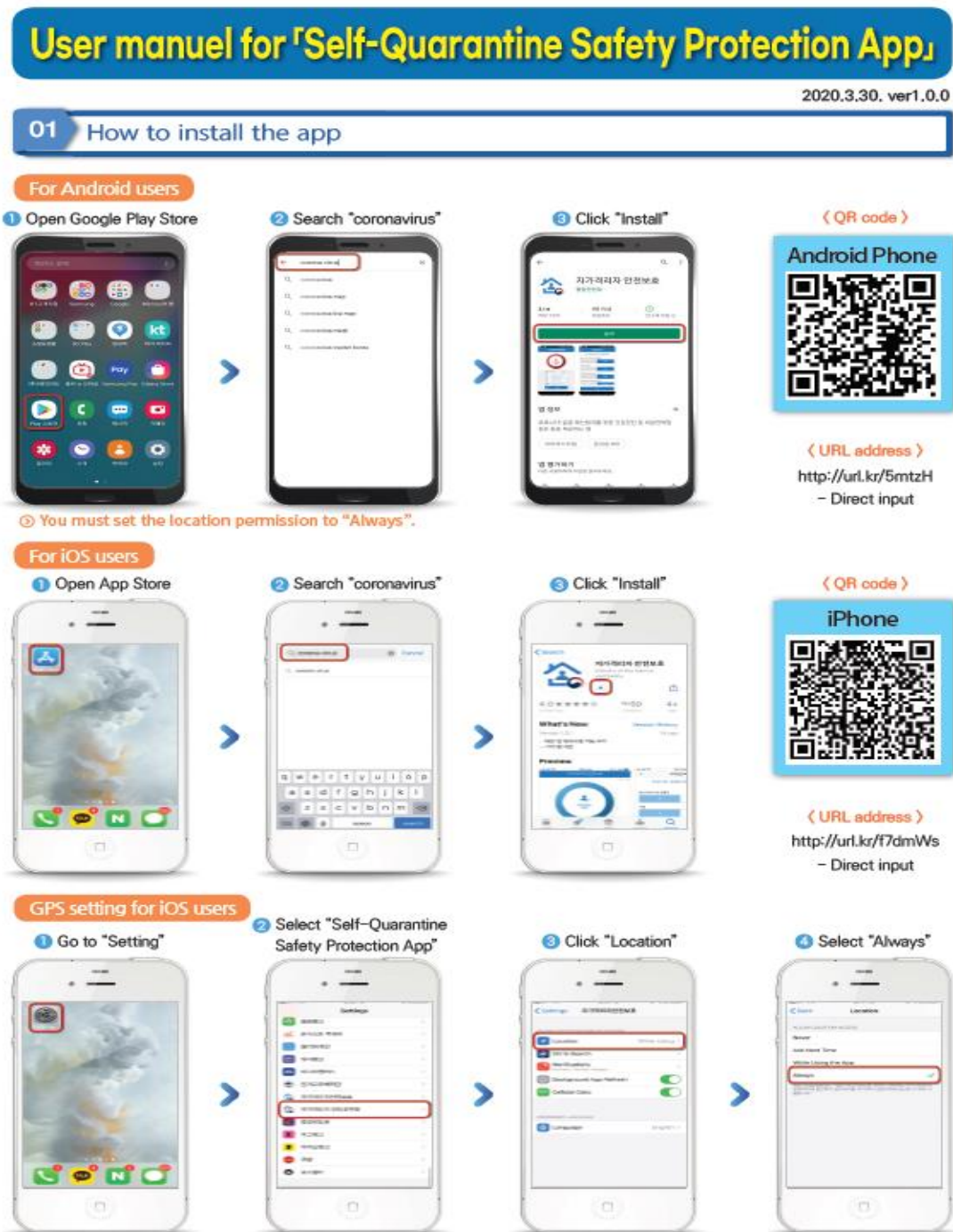


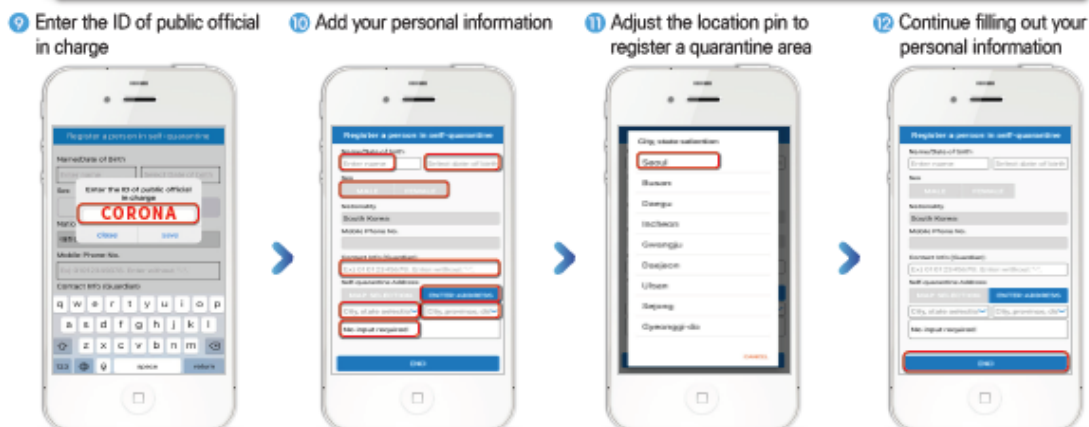
Figure 13 User Manual for Self-Quarantine Safety APP



02 Select language and consent to collection of personal information

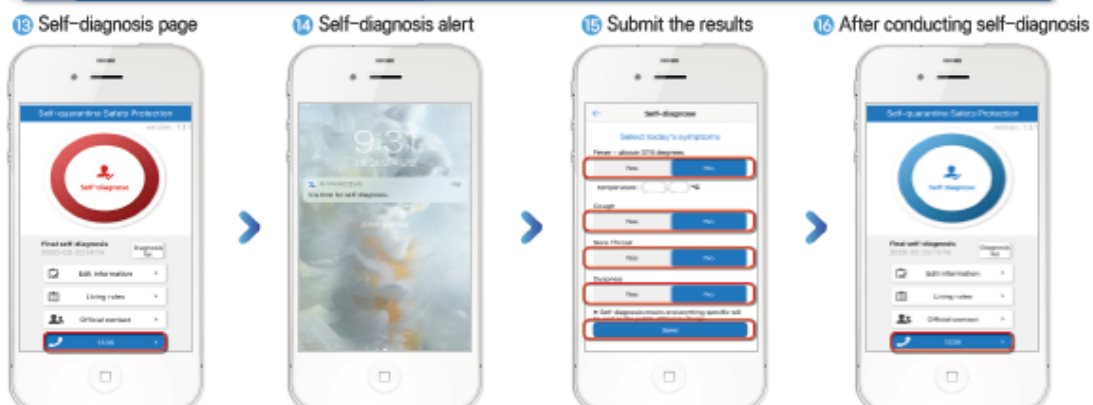


03 Enter the ID of public official in charge and personal information(For overseas immigrants)



- ① In order to proceed to the next page, you need to enter the ID(CORONA) of your assigned case officer.
- ② When entering your quarantine address, select the city/state and city/province/district you plan to stay in.
- ③ You do not need to enter the detail address.

04 Self-diagnosis



- ① A user needs to conduct self-diagnosis twice a day.
- ② A user can conduct additional self-diagnosis in addition to the pre-scheduled ones.

4.3 Data Based Epidemiological Investigation

Contact tracing is an important part of epidemiological investigation. The Korean government introduced various investigation methods after the MERS outbreak in 2015 to enhance the accuracy of investigations and to overcome the limitations of interview-based investigations, which depend on memories or honesty of the interviewee. This was legally supported by the amendment of the Infectious Disease Control and Prevention Act (IDCP Act) in December 2015. Then, in April 2017, the Korean government introduced the Advancement of Smart Quarantine Information System, which is a quarantine information project that utilizes the overseas roaming data to identify those coming into the country from high-risk regions and to monitor them during the incubation period of the infection. Later, the government also worked with a telecommunication company and a card company to set up a system that utilizes communication network and card transactions to trace the transmission of infectious disease into Korea and then within Korea. Based on the IDCP Act, therefore, the quarantine authorities of Korea utilize not only patient statement but also personal information through location tracking, card transactions, and CCTV recordings for accurate tracing of transmission.

Prompt support system for data-driven COVID-19 epidemiological investigation has been established, and strong security measures have been put in place to ensure data privacy.

Infectious Disease Control and Prevention Act (Article 76-2)

① If necessary to prevent infectious diseases and block the spread of infection, the Minister of Health and Welfare or the Director of the Korea Centers for Disease Control and Prevention may request public institutions, medical institutions, pharmacies, corporations, organizations, and individuals to provide information (name, resident registration number, credit card transaction records, records of immigration control, records of medical treatment) concerning patients with an infectious disease and persons likely to be infected by an infectious disease.

② If necessary to prevent infectious diseases and block the spread of infection, the Minister of Health and Welfare may request police agencies to provide location information of patients, persons with an infectious disease and persons likely to be infected by an infectious disease. In such cases, the relevant head of a police agency, upon request by the Minister of Health and Welfare, may request any telecommunications operator to provide location information of patients with an infectious disease and persons likely to be infected by an infectious disease. (Amended in December 2015)

Korea's Epidemiological Investigation on Infectious Diseases

Korea conducts epidemiological investigations based on the Infectious Disease Control and Prevention Act (IDCP Act). In accordance with Article 18 of the Act, the Director of the Korea Centers for Disease Control and Prevention, a mayor, a governor or the head of a city or a county must establish an epidemiological investigative team to conduct an epidemiological investigation without delay against concern over a possible infectious disease outbreak. The information on the findings, then, must be provided to the relevant medical institutions to a necessary extent.

This central epidemiological investigative team conducts the investigation when two or more cities or provinces require epidemiological investigations, when the investigation by the mayor or the governor is found to be insufficient or impossible, or when there is an urgent need to investigate whether there is an outbreak and prevalence of an infectious disease.

The epidemiological investigative team under jurisdiction of each city, province or county conducts the investigation when it is likely for an infectious disease to break out and become prevalent in an area, or when it is likely for an infectious disease to break out and become prevalent outside an area but it is suspected that the infectious disease is epidemiologically related to the area (Article 18-1 of IDCP Act; Article 13 of the Enforcement Decree).

Figure 14 Smart Quarantine System Utilizing Roaming Data

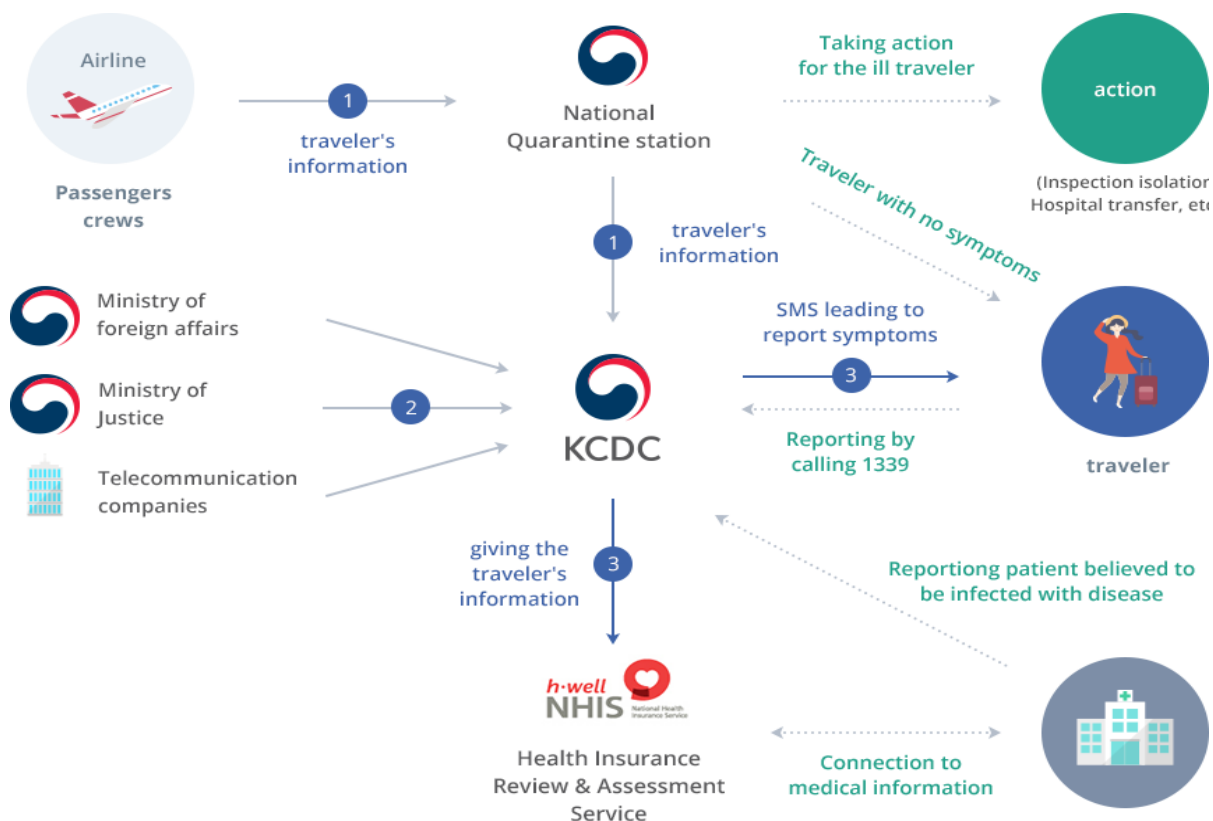
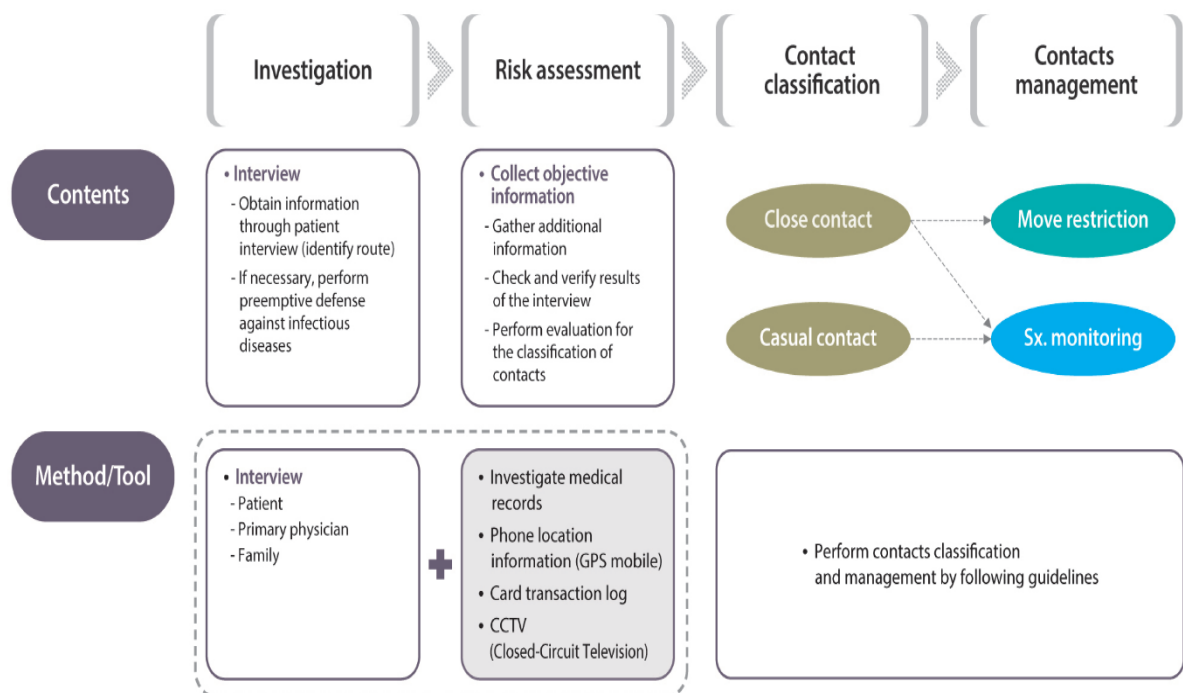


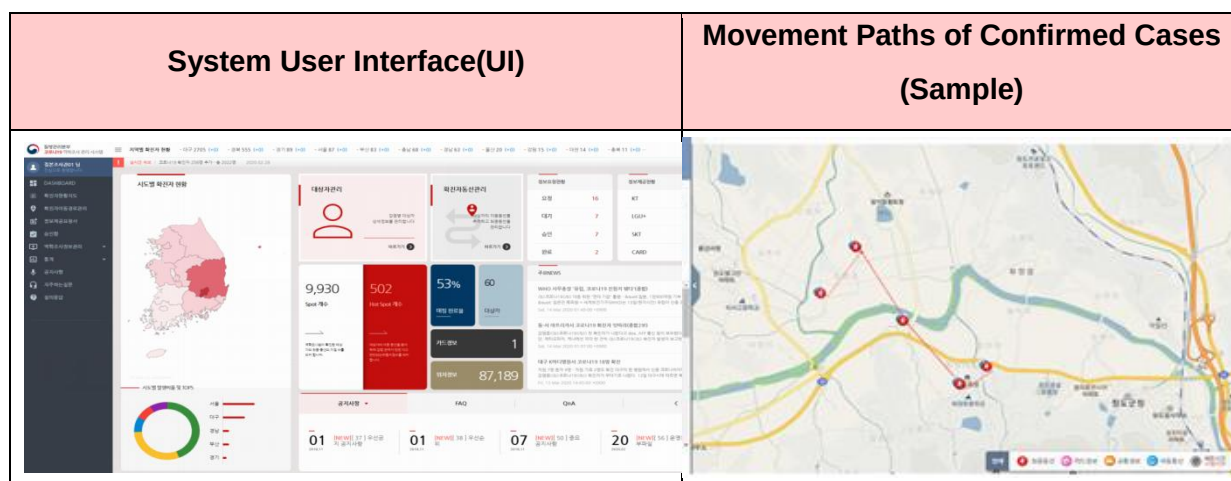
Figure 15 Stepwise Approach in Monitoring Contacts When a Patient with COVID-19 is Detected



4.4 Epidemiological Investigation Support System

With the spike in the number of confirmed cases in Daegu City and Gyeongsangbuk-do, there was heavy workload for the epidemiological investigators. This sparked a discussion that a computer-aided system was necessary to quickly and accurately analyze the large amount of data. As a result, the COVID-19 Epidemiological Investigation Support System was developed to support epidemiological investigations through the application of City Data Hub under the National Strategic Smart City R&D Program. This platform went through a ten-day pilot operation from March 16 before being officially launched on March 26 with improved operating system and procedures on handling personal information. The Ministry of Land, Infrastructure and Transport has transferred operation of the system to the KCDC, which runs in close coordination with the National Police Agency, Credit Finance Association of Korea, 3 telecommunications companies and 22 credit card companies. The COVID-19 Data Platform is designed to support epidemiological surveyors to quickly identify the transmission routes and places that the infected has visited by using real-time analysis of data such as GPS, mobile information and credit-card transaction history to conduct a spatial-temporal analysis. The platform supports health officials in confirming the interview results of patient transmission routes with the data on the system. Moreover, the big data analysis allows officials real-time data feeds on COVID-19 patients, including their whereabouts and the time spent on each location. From these multiple data points, the system can detect incidents of cluster infection and show the source of transmission.

Figure 16 COVID-19 Epidemiological Investigation Support System



In accordance with the Infectious Disease Control and Prevention Act, the epidemiological investigation for COVID-19 requires the Minister of Health and Welfare to request location information of patients from the National Policy Agency, and then from telecommunication companies via 18 regional police agencies and district police stations. Completing this process can take up to 24 hours. With the new platform, however, the information is requested and then submitted in a single batch via an online system, allowing data to be collected within 10 minutes.

Figure 17 COVID-19 Data Collection Procedure Before & After COVID-19 Epidemiological Investigation Support System

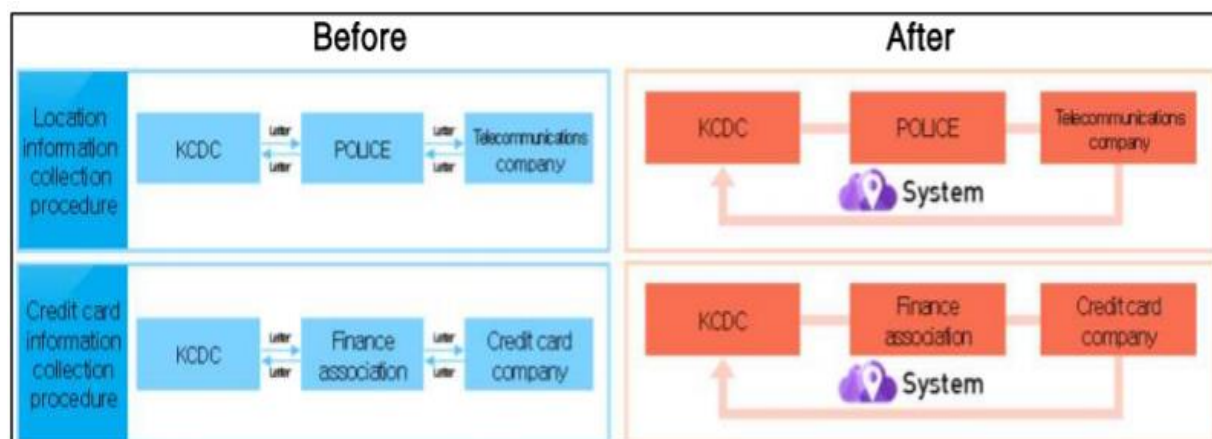


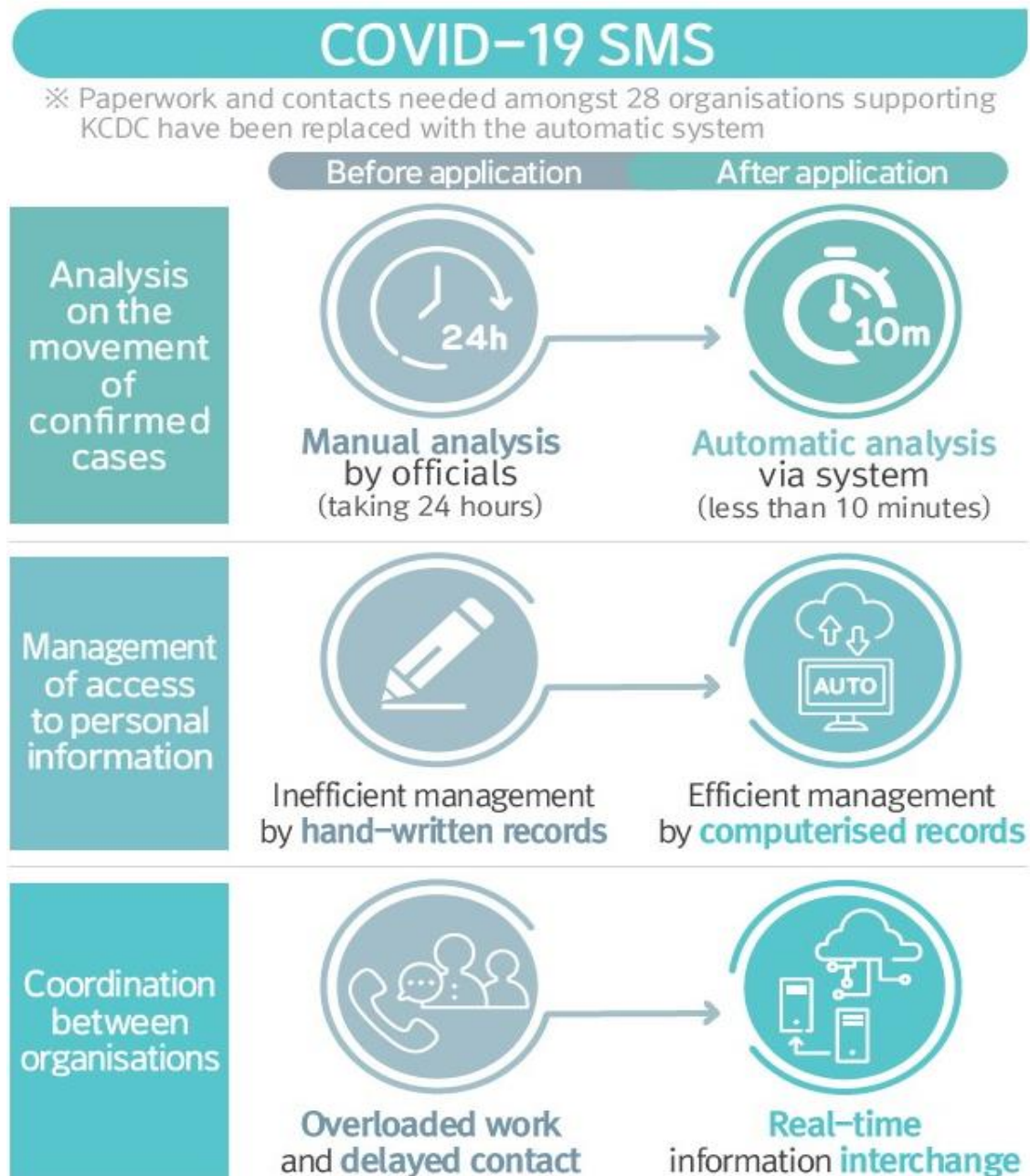
Table 3 Benefits of COVID-19 Epidemiological Investigation Support System

	Before	After
Contact tracing method (time per case)	Manually tracked by health workers (one day per case)	Automated tracing (ten minutes per case)
Management of access record	Writing into a paper ledger	Automated tracking of log-in records
Coordination among agencies	Fragmented coordination by phone, e-mail	Multi-agency coordination under a central platform

The COVID-19 Epidemiological Investigation Support System operates in a strict manner to protect privacy, with the scope of collected data kept to minimum and a due procedure followed in acquiring data. Epidemiological investigators must seek approval from relevant authorities to access the data only when there is a clear need to collect additional personal information. For example, separate permission from the National Police Agency is required to access location information. To protect the information gathered, access to the platform will be granted only to a few officials, with level of access differentiated according to the requirements of their duties. Under the current arrangement, the KCDC officials and local government officials in charge of contact tracing have the necessary security clearance, while other government agencies do not. The platform runs on a private network to shield the system from hacking and adopts advanced security technologies like double firewalls as well as a thorough management of log-ins. Abuse of personal information can be prevented as the activities of each user is under strict surveillance. The platform operates on an interim basis, and all the personal data stored in it will be deleted once official response to COVID-19 is complete. While in operation, the platform is constantly monitored by computer security experts, and the security regime for data protection is regularly updated.

The City Data Hub that powers the COVID-19 Data Platform is a newly-developed urban big data integrative platform initiated under the NSSC Program. It is the cloud-based open data hub to collect, store, process, analyze and publish the cross-functional data in a holistic way, covering the domains of mobility, energy, environment, healthcare, safety, etc. The NSSC Program has been initiated since 2018 with an aim to develop a standardized open architecture of City Data Hub that will be demonstrated for various service areas in Daegu Metropolitan City and Siheung City located in Gyeonggi Province.

Figure 18 COVID-19 Epidemiological Investigation Support System

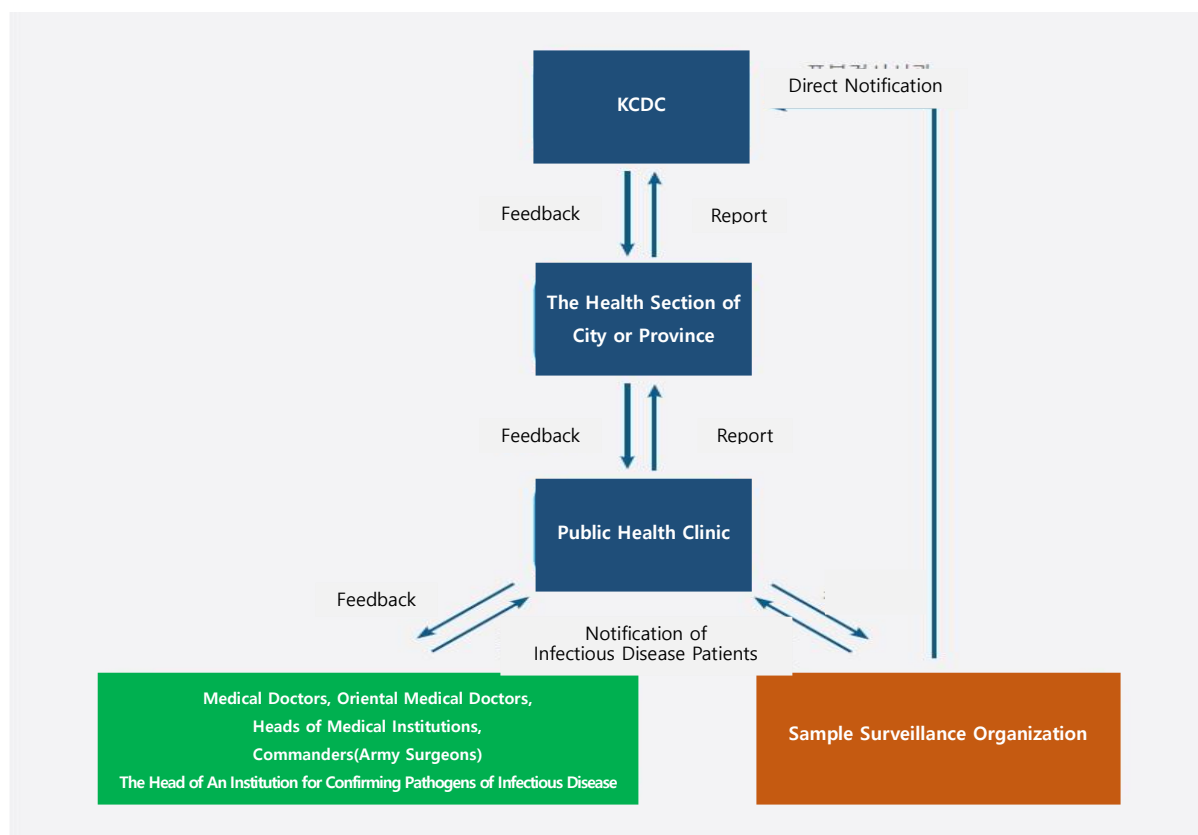


4.5 Integrated Disease and Health Management System

Currently, there are two parts to Korea's surveillance of infectious diseases. Under the Mandatory Surveillance System, reporting is mandatory for all those obligated to notify, while under the Sentinel Surveillance System, reporting is mandatory for only the sample medical institutions that participate based on certain criteria. These systems apply to 80 types of infectious diseases. COVID-19 has legally been classified as a new infectious disease syndrome under Group 1 of infectious diseases, which is subject to the Mandatory Surveillance System where all those obligated to notify must report to a health center when a patient with an infectious disease is identified, in order to prevent an outbreak and prevalence of the infectious disease.

As the ones obligated to notify, medical doctors, oriental medical doctors, heads and sub-heads of medical institutions must report to a public health clinic without delay as soon as pathogens of infectious diseases are confirmed or a patient is diagnosed with the infectious disease. In addition, the head of an institution for confirming pathogens of infectious diseases is also required to report to the public health clinic as of 2016. Based on the surveillance system, the cases reported to public health clinics are reported to the city or provincial offices, and ultimately to the Korea Centers for Disease Control and Prevention (KCDC). Certain infectious diseases under monitoring may also be directly reported to the KCDC through the Integrated Diseases and Health Management System. The data collected through the system is then shared through various channels. One main example of this channel is the 'Web-Statistics on Surveillance of Infectious Diseases' where the disclosed data are categorized by time and region.

Figure 19 Integrated Disease and Health Management System



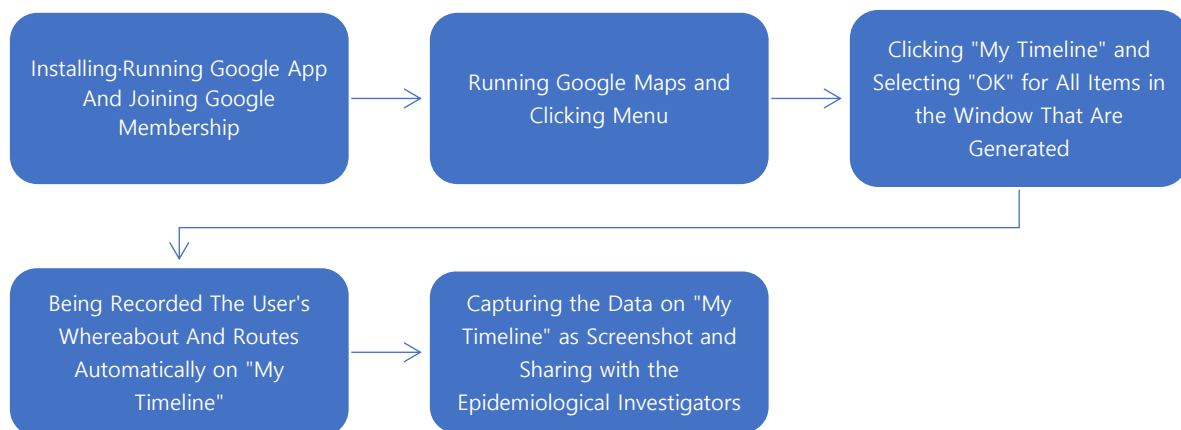
4.6 A guide to record location history (Jeju-do Island)

Jeju-do, as the southernmost island of Korea, only has 7 epidemiological investigators, and had difficulty managing the spread of COVID-19. It was a time consuming task to trace patient contacts through memory-based patient statements and CCTV recordings.

To overcome such challenge, Jeju-do has launched a campaign on February 24 to have its citizens voluntarily record their whereabouts on their smartphones using Google Timeline. By turning on 'My Timeline' function on Google Map application, the user whereabouts and routes are recorded automatically. If ever necessary, the data on Google Timeline can be captured as screenshots and shared with the epidemiological investigators, who will use the data to trace contacts and patient routes.

Jeju-do is promoting participation in the campaign on its website with a guide on how to install and use Google Timeline function on Google Map.

Figure 20 A guide to record location history of Jeju-do Island



5. ICT facilitates COVID-19 TREATMENT



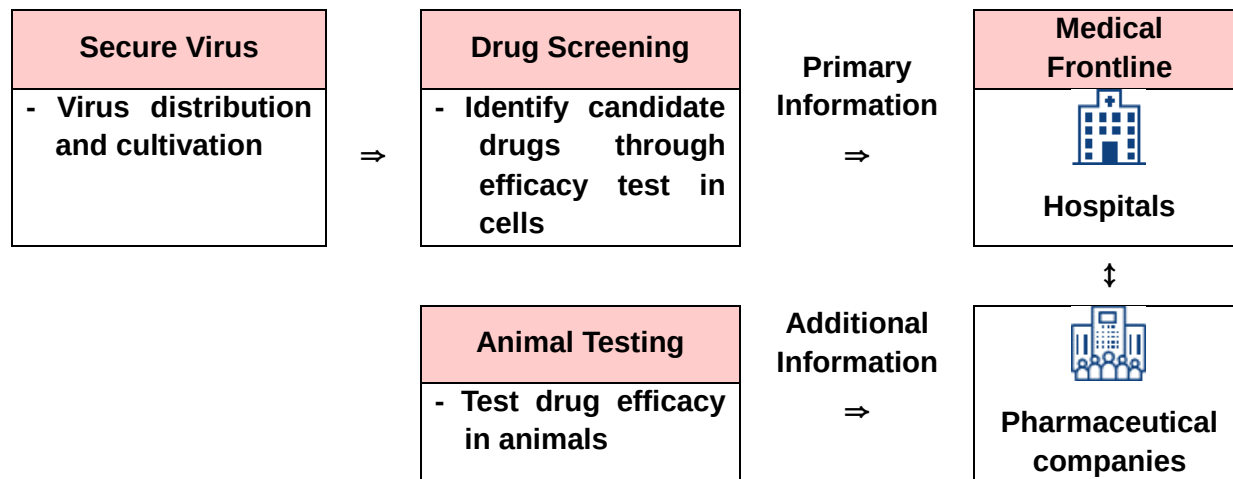
5. ICT facilitates COVID-19 TREATMENT

5.1 Research to facilitate drug repurposing

Research to facilitate drug repurposing

The government, research institutes and businesses have cooperated to identify candidate drugs for COVID-19 treatment through drug repurposing, and conducted clinical studies with confirmed patients. To secure treatments for COVID-19 as quickly as possible, the Korean government is supporting the repurposing of drugs to identify those that are effective against COVID-19. Compared to the development of a new treatment, which generally takes over a decade, drug repurposing only requires efficacy evaluation and can help find COVID-19 treatment in the near future. To maximize the capabilities and resources of relevant agencies for effective drug repurposing research, the Korean government formed a drug repurposing council, composed of the Korea Research Institute of Chemical Technology (KRICT), Institute Pasteur Korea, the Korea Research Institute of Bioscience and Biotechnology (KRIBB), the Korea Mouse Phenotyping Center (KMPC), and Korea University. Drug repositioning aims to validate the efficacy of existing drugs in cells (drug screening), provide the results to healthcare professionals, and test the repositioned drug to patients. Animal testing might be put in place for efficacy validation to provide additional information to healthcare workers.

Figure 21 Drug Repurposing Process



Drug screening is being conducted by Institute Pasteur Korea and KRICT. Institute Pasteur Korea has identified about 20 drugs effective against COVID-19 and posted its research findings on BioRxiv (biological science archive) on March 21. In particular, ciclesonide (marketed as Alvesco), which can be inhaled directly into the lungs, was found to be very efficacious and has been approved for clinical trial by the Korean government on March 27. The clinical trial will be conducted at Korea University Guro Hospital with 141 COVID-19 patients with mild symptoms. KRICT has conducted screenings for domestic and foreign drugs requested by healthcare professionals and shared its research findings on

eight drugs including Remdesivir, Chloroquine and Kaletra with frontline clinical doctors through the Korean Society of Infectious Diseases (KSID). Institut Pasteur Korea and KRICT are also conducting large-scale screenings for 2500 and 1500 drugs respectively, with results expected by mid-April. Animal testing is also being prepared to provide healthcare professionals with additional information about drug efficacy. Currently, KRIBB is designing a research model with nonhuman primate infected with COVID-19, using monkeys at the institute. The research model is expected to be ready by early May, and KRIBB will start the research to test treatment effectiveness on nonhuman primates. The KMPC is developing a COVID-19 infected model mouse, considering the possibility of virus mutation.

The Korean government has secured emergency response research budget and supplementary budget in order to provide support for drug repositioning research. The emergency response research budget has been allocated for drug repositioning research and clinical trials. The supplementary budget will be used to screen drugs, conduct clinical studies and provide better equipment and drug library. Supercomputers are also being used in identifying candidate substance. The Korea Institute of Science and Technology Information (KISTI) is conducting research using supercomputers to develop a drug that can contain protease, an enzyme used by COVID-19 for replication.

5.2 Developing medicine using AI

Furthermore, the use of AI is expected to reduce the time required to develop medicine, as AI can learn and make deductions based on the virus and other medical data. Company D, which develops new medicine and relevant platforms through the use of AI, used deep learning algorithms to predict the interaction of drug and protein, and propose candidate medicine for the coronavirus. Company D and the research team at Danguk University under Kang Geunsoo have used AI to analyze the antiviral drugs on the market to predict medicines that may be effective against the COVID-19. The result of this study was published through a BioRxiv under the title, 'Predicting commercially available antiviral drugs that may act on the novel coronavirus (2019-nCoV), Wuhan, China through a drug-target interaction deep learning model.' According to the research, Company D and the researchers used pre-trained deep learning-based drug-target interaction model called Molecule Transformer-Drug Target Interaction (MT-DTI) to identify commercially available drugs that could act on viral proteins of SARS-CoV-2. The result showed that atazanavir, an antiretroviral medication used to treat and prevent the human immunodeficiency virus (HIV), is the best chemical compound. In addition, the researchers also found that several antiviral agents, such as Kaletra, could be used for the treatment of SARS-CoV-2. Overall, the research suggests that the list of antiviral drugs identified by the MT-DTI model should be considered, when establishing effective treatment strategies for SARS-CoV-2.

5.3 Developing medicine using platform

Company A, an AI-driven drug discovery start-up using bioinformatics and pharmacogenomics for incurable and rare diseases, has been developing platforms to find candidate substances to treat COVID-19 more efficiently.

Figure 22 AD3 Drug Designer by Company A

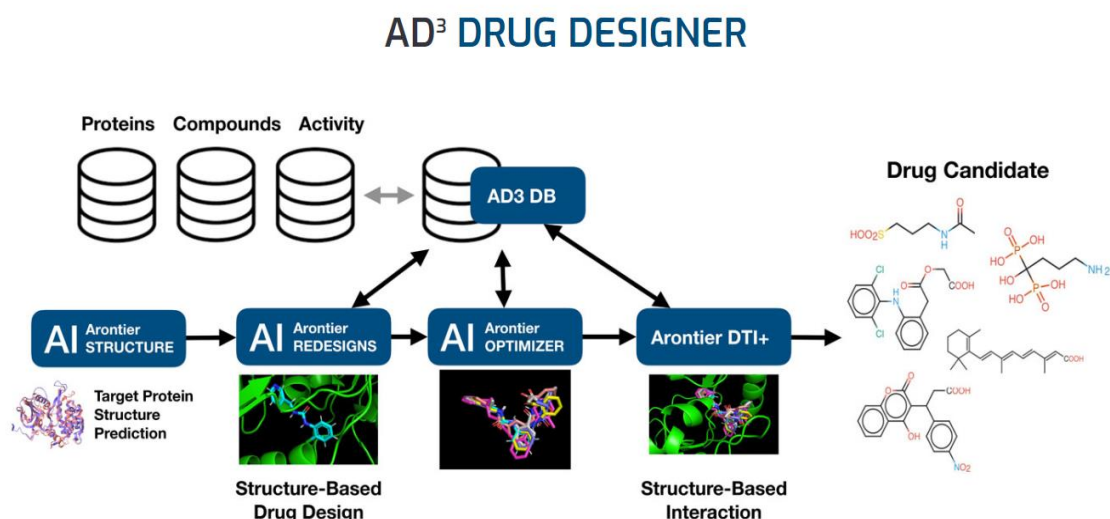
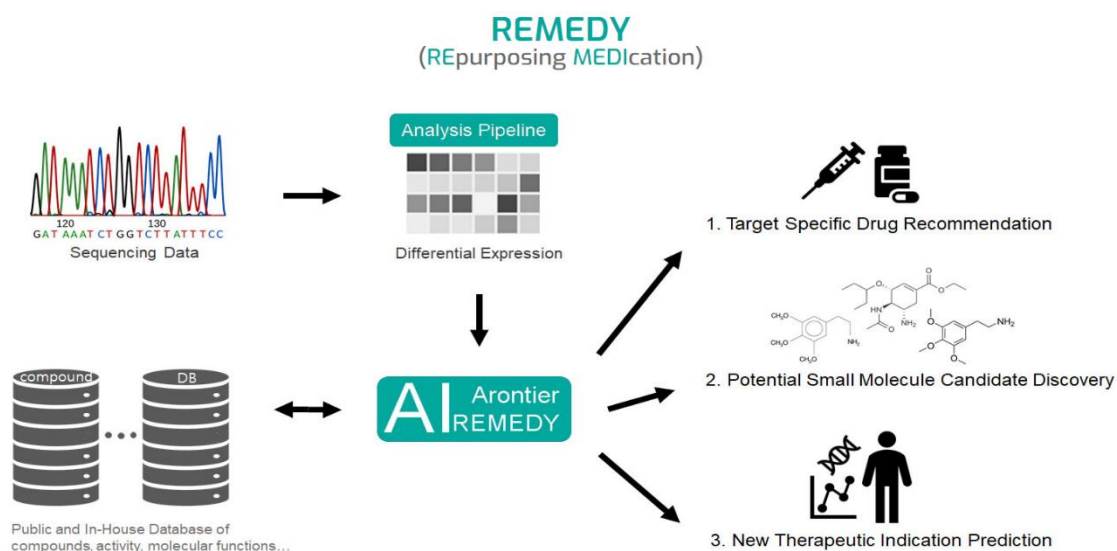


Figure 23 Repurposing MEDication(REMEDY) by Company A



6. ICT FLATTENS the curve on COVID-19



**South Korea is
flattening the curve
on COVID-19**

6. ICT FLATTENS the curve on COVID-19

6.1 Release of COVID-19 open government data

On February 5, 2020, the Korean government established an official website on COVID-19 (<http://ncov.mohw.go.kr/en>), where all relevant information is available for the public. Comprehensive data such as daily case count in the country, quarantine process, regular briefings by the government, and instructions for those under quarantined are provided. Data such as confirmed cases are screening centers are available in CSV and open API formats to allow immediate use.

Key information such as the accumulated count by region and number of tests performed is summarized and provided as visualization data on the main page of the website. Information on providing overseas travel history, finding COVID-19 screening centers, early-detecting of patients, using epidemiologic surveys and isolating the close contacts of a patient are also provided accordingly. The website is available in 3 languages (Korean, English, and Chinese).

Figure 24 Main Page of Korea COVID-19 Website



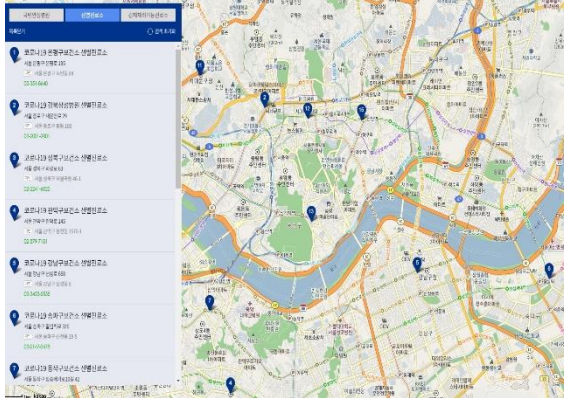
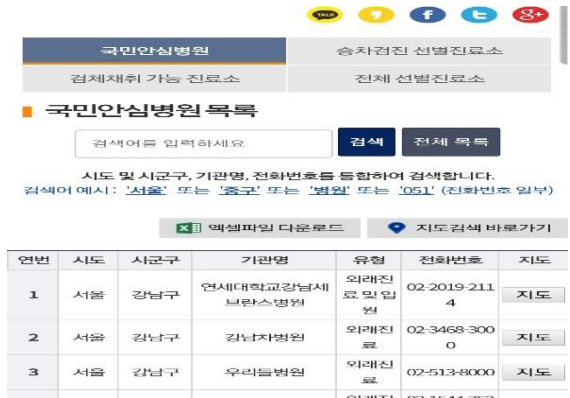
Ministry of Health and Welfare and the Health Insurance Review & Assessment Service(HIRA) provide the data that become available on the official website and on open data portals. Ministry of Interior and Safety, and the National Information Society (NIA) process and release the data on the open data portal (<https://www.data.go.kr/main.do?lang=en>) in API format.

Data on national security hospitals* (name of institution, address, application type, availability of test, phone number) and screening centers (name of institution, address, phone number) are released to the open data portal in API format and are updated every day at 6 a.m.

* National security hospital separates the treatment process for respiratory and non-respiratory patients to prevent COVID-19 infection in the hospital.

Using open government data, private sector developers such as civic hackers, startups, community of developers, portal service were able to launch an application and web services that help the public find national security hospitals and screening centers.

Figure 25 Application and Web Services to find National Security Hospital and Screening Centers

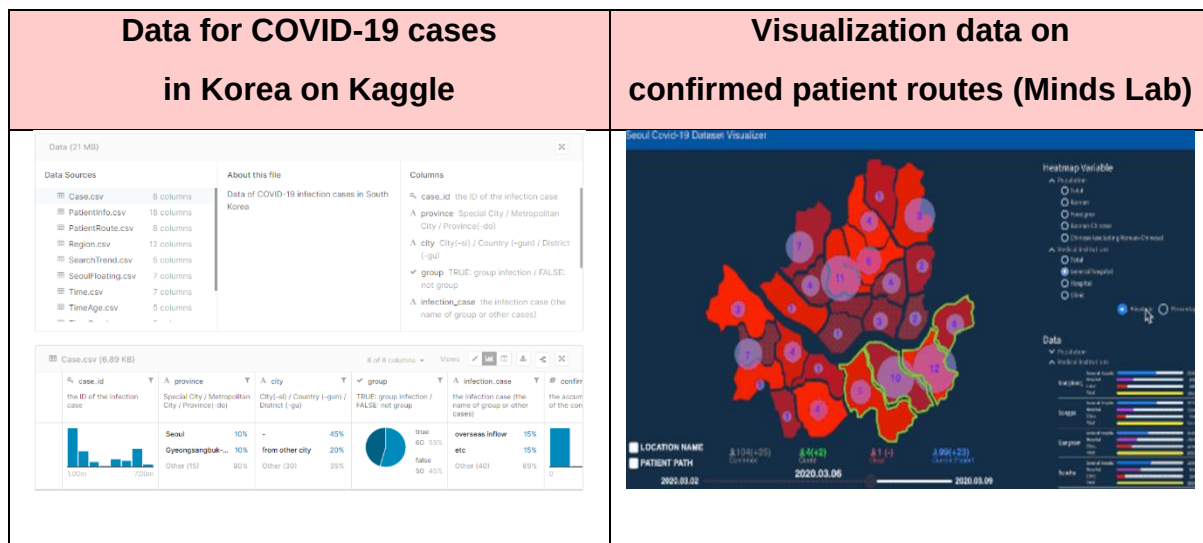
Finding nearby screening centers	A list of national security hospitals (National COVID-19 screening center app)																																			
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The Korean government provides various dataset such as public mask sales data and national and international confirmed cases to local government websites and the open data portal. IT engineers and the general public utilize the data to create for public interest data which have been shared globally.

Ministry of Health and Welfare (MOHW), Ministry of the Interior and Safety (MOIS), Ministry of Science and ICT (MSIT), National Information Society Agency (NIA), and Health Insurance Review & Assessment Service (HIRA) have worked together to provide public mask sales data in open API format by collecting real-time sales data of public mask at state-designated sellers. API has been publicly available, allowing the private sector to develop various online and mobile services that enable citizens to check the location of place and availability of public masks.

MOHW also collects COVID-19 related data, relays it to the open data portal. Then, MOIS and NIA processed the data in an open API format and provides the data to open data portal.

Developers and IT companies gather information from local government websites. And after, repackaging the data by adding geographic information such as latitude and longitude. Through reprocessing, subdivided data in infection path and cases of COVID-19 are now available on global platform kaggle.

Figure 26 Data for COVID-19 Cases


6.2 Publicly Distributed Mask Information Service

Real-time data of publicly-distributed face masks is provided to people through mobile applications and web services, reducing confusion and inconvenience while raising distribution efficiency. With people's growing concerns over face mask shortages, the Korean government adopted diverse measures to secure mask supplies for the citizens, most notably a five-day rotation face mask distribution system. Under this system, purchases are limited to two masks per person each week, available only through public retail platforms and on designated days of the week depending on birth year. The five-day rotation face mask distribution system rolled out on March 9 allowed people to buy face masks through public retail platforms, such as government-designated pharmacies, post offices and Nonghyup Hanaro Mart stores. Providing information about how many masks are left in stock at each retailer was necessary to reduce confusion and inconvenience among people.

Considering the urgency of providing information about face mask sales and ensuring stability of information system, the information service is based on the public-private partnership approach taken by the Korean government, developers community and private companies. The government releases the data on face masks sold at public retailers, cloud companies provide cloud and map resources needed for service development and provision, and private developers use the data to develop and provide information services for the public. The data on face masks sold at public retailers were released at 7 p.m. of March 10, and starting at 8 a.m. of March 11, private developers launched applications and online services on face mask retailers and stocks

People can visit mobile websites created by private web portal companies and developers or download mobile apps to check face mask stocks at public retailers. The stock quantity is displayed in four different colors according to the number of masks left in stock: 100 or more (green), 30 – 99 (yellow), less than 30 (red), out of stock (grey)

As of late March, there are currently more than 150 different web and app services providing relevant information about face masks sales, and the government's app/web service portal provides a list of available services. The number of data call related to mask distribution through data API cloud reached 570 million (9.64 million per hour) from March 11 to 31.

* App/web service portal: <https://mask.paas-ta.org>

Figure 27 Publicly Distributed Face Mask Information Service

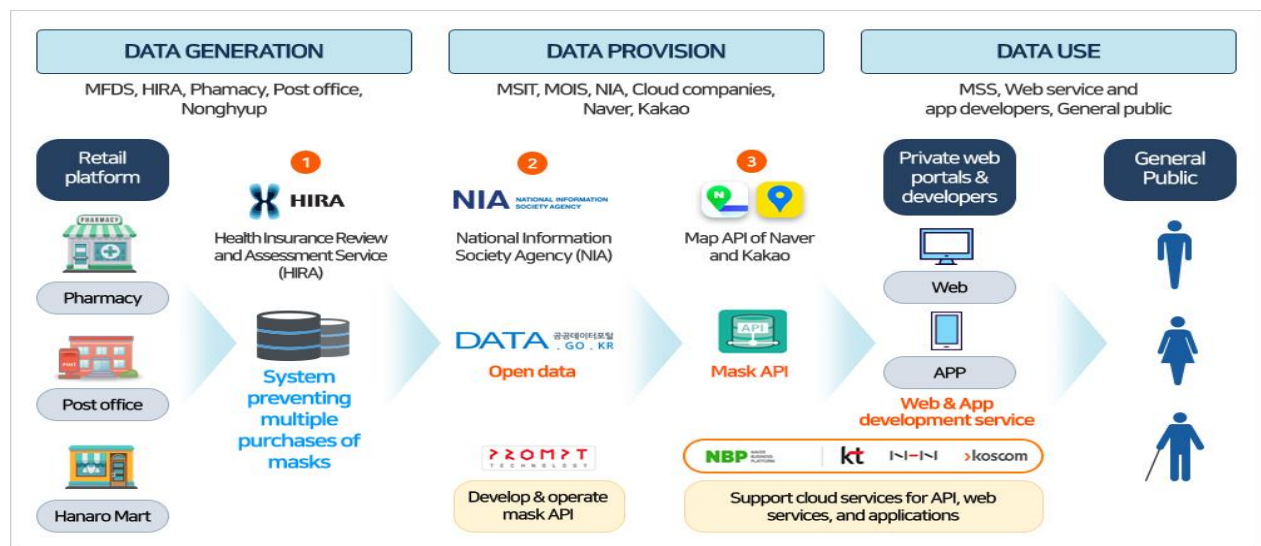


Table 4 Three Steps of Publicly Distributed Face Mask Information Service

Data Generation	Basic data of face mask sales by retailer, such as a pharmacy, post office, Nonghyup Hanaro Mart, is created using the Health Insurance Review and Assessment Service (HIRA)'s system* preventing multiple purchases of masks sold through public retail platforms * Under the current five-day rotation system limiting purchases to two masks per person each week, retailers put the number of masks buy each person into the system for efficient management of supply.
Data Provision	The public data center of the National Information Society Agency (NIA) processes HIRA's data to be accessible to the general public (open data) and releases the data in the format of Open API through cloud services* offered for free by the private sector. * Cloud infrastructure is used to prevent connection delay due to traffic overload and provide flexible services.
Date Use	The cloud alliance* offers cloud services including server and development software to companies and startups for free (for two months), and developers use such services to create and operate new applications and web services. * The platform-as-a-service (PaaS-TA) alliance forged by Naver, KT, NHN, and Koscom

Since the launch of the face mask information service, people can easily find the pharmacies that have enough stock of face masks. The number of pharmacies that sold all of their mask supplies increased after the service was launched (67.9% on March 10 → 86.4% on March 21).

The service is getting positive feedback, as inquiries about retail platforms from people and about information system from retailers decreased since the release of the service (480 inquiries on March 11 → less than ten inquiries in late March), which has resulted in less burden for retailers selling face masks.

With the five-day rotation mask distribution system, purchases are limited to two masks per person each week with a valid ID, making it difficult for the family members residing abroad, the elderly, the disabled and pregnant women. Therefore, the Korean government allowed the masks to be sent to family members residing abroad (up to eight masks a month per overseas resident) with the following exceptions allowing for proxy purchasing of public masks.

Table 5 Eligibility and Required Documents for Proxy Purchasing of Public Masks (as of April 6)

Eligibility	Proxy Eligibility (the one making the purchase)	Required Documents
Year of birth before 1940	Co-habitant of the eligible	• ID of the proxy • Copy of the resident registration certificate, listing the eligible and the proxy as co-habitants
Year of birth after 2002	Co-habitant of the eligible	• ID of the proxy • Copy of the resident registration certificate, listing the eligible and the proxy as co-habitants
Beneficiary of long-term medical care benefits	Co-habitant of the eligible	• ID of the proxy • Copy of the resident registration certificate, listing the eligible and the proxy as co-habitants • Certificate of long-term medical care benefits
Disabled		• Disability registration
Pregnant Women	Co-habitant of the eligible	• ID of the proxy • Copy of the resident registration certificate, listing the eligible and the proxy as co-habitants • Proof of pregnancy
persons receiving veteran's benefits and with disability		• Veteran's identification
Those living in a nursing facility	Nursing facility staff	• Proof that the proxy works at the nursing facility • Agreement form signed by the nursed
Beneficiary of long-term medical care benefits in a nursing facility	Nursing facility staff	• Proof that the proxy works at the nursing facility • Certificate of long-term medical care benefits of the nursed
Inpatient	Co-habitant of the eligible	• ID of the proxy • Copy of the resident registration certificate, listing the eligible and the proxy as co-habitants • Proof of hospitalization

6.3 Policy-making using big data (Busan)

Busan City has analyzed the COVID-19's impacts on citizens' spending amount and activities, on which coping policies with the pandemic were established.

1. Decreasing activities by each living area, which negatively related on monthly income of blue colour group.
2. Sloping down in sales amount of every shop in the city, estimating the possible decrease in tax income in near future and next year
3. Growth in weekly sales amount of this year to last year by every category, targeting and prioritizing most urgently requested shops for providing the anti-disaster basic income
4. Tracking the geo-spatial data of confirmed cases, which gave epidemiological insights of where to focus first.

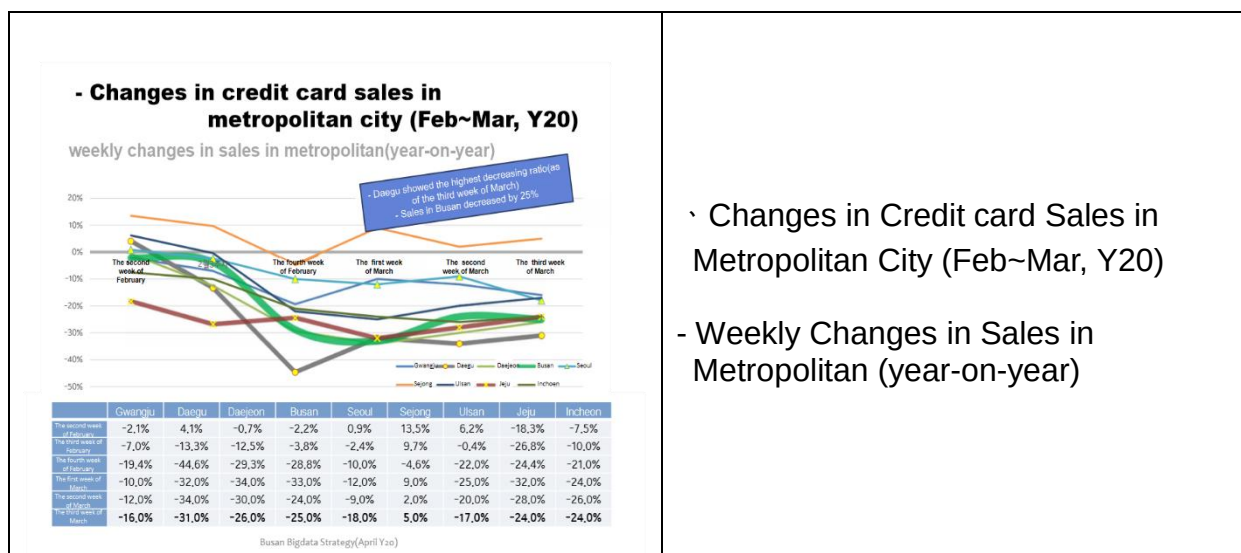
Decreasing activities were monitored by cellular data from mobile telecoms by every age-band and by each living area, compared to months before the pandemic, which gave insights on how many moving activities were decreased by social distance policy, and directly impacted on their daily working for a living.

Sloping down in sales amount of every shop in the city was reported to the officer of tax income department, which gave estimated number of tax income in near future and next year by each district area and industry code, but requested coping strategy for next year's budget policy.

Growth in weekly sales amount of this year to last year by every category was analyzed with daily purchase data from credit card companies by each customer segmentatin as well as by each category every shop belonged to, which was based for targeting the anti-disaster basic income.

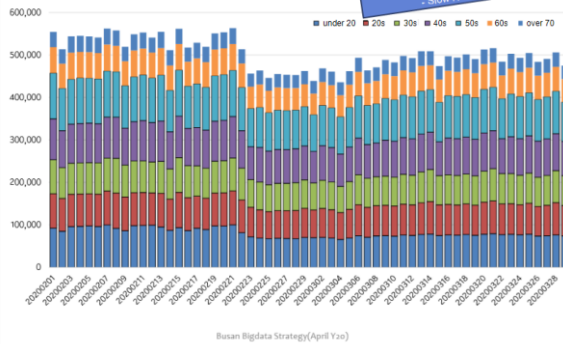
Tracking the geo-spatial data of confirmed cases generated the links of places visited by the cases, which gave the insights on the path of spread as well as treatment efficiency.

Figure 28 Example of analysis report of Busan



- Changes in the number of population influx

- The number of population influx by age group (2/1~3/29, buk-gu in Busan)

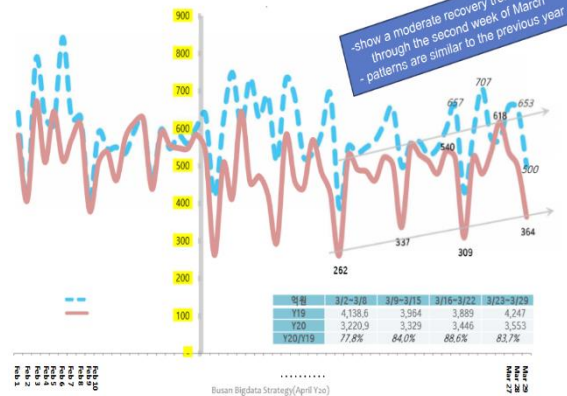


Changes in the Number of Population Influx

- The Number of Population Influx by Age group (2/1~3/29, buk-gu in Busan)

- Impact of COVID-19 on Weekly Sales Amount of Busan Korea

- Tracking Weekly Sales Amount (2/1~3/29, 100MillionKRW)



Impact of COVID-19 on Weekly Sales Amount of Busan, Korea

- Tracking Weekly Amount(2/1~3/29, 100Million KRW)

6.4 Online sales of agricultural products

In terms of agricultural products, farms have suffered damage due to the delay in supply of school meals as schools begin classes online and the general decrease in consumption. To provide assistance, local governments have directly hosted special events for local produce. In Gyeongsangbuk-do, the 40 kinds of processed goods and fresh produce including red ginseng, black garlic and honey are sold through 16 affiliated online shopping malls at about 30 to 50% discounted price. For 24 key marine products, 2 large online shopping companies have been utilized. In Jeollanam-do, sales of local agricultural and marine products have been listed on G-market, Auction, and Post Office Shopping Sites, and with the live-broadcasting that encourages viewers to purchase local produce has also been successful. Because of such online sales of agricultural and marine products under a regular distribution network, there has not been panic-buying in Korea. According to Lee Eun-hee, a professor of Consumer Science in Inha University, there are largely 2 reasons why there is no panic-buying in Korea.

- Transparent and accurate delivery of information and top-class medical and testing system eliminates unnecessary fear
- Well-developed delivery system for food and online shopping, with diversity in vendors such as local supermarkets and convenience stores.

Picture 8 Live Broadcasting Selling Local Agricultural Products



6.5 Response to Telecom Scams

The Korean government is implementing measures to enhance response to scams, as phishing (by phone) and smishing (by SMS) attacks are on the rise, preying on fears of COVID-19. The government has enhanced the scam alert system in cooperation with the three major telecommunications service providers. Alert texts are sent out on a regular basis (every week or every other week) to inform all citizens of cases of scams and coping methods (started with some telecoms and later expanded to all telecoms).

Caution on COVID-19 Related Phishing and Smishing Attacks

Recently, there have been frequent phishing and smishing attempts impersonating health authorities or COVID-19 confirmed patients asking for money or inducing access to suspicious URLs, so please be extra careful.

- ① If you receive a call asking for money or access to a suspicious URL (or downloading an app), please hang up and report to the National Police Agency (☎112) or the Financial Supervisory Service (☎1332).
- ② If you have received a suspicious text message or suspect your phone being infected with a malicious app, please report to 118.

The damage prevention system has also been strengthened in cooperation with telecommunications service providers and security firms. The system encourages the use of apps that help prevent phishing (e.g. Whowho), supports the development of mobile antivirus software, and promotes various services* protecting users from mobile-phone based scams

- * 1) Service restricting subscription: a service restricting new subscriptions or transfer registration
- 2) Service blocking phone number theft: a service preventing sending text messages from the subscriber's phone numbers using online websites
- 3) Kill-switch: a function to remotely control and delete personal information in a smartphone to prevent any abuse of information inside a lost phone

The government has also improved the response system against telecommunications scams. Upon the report of the scam cases, the number used for phishing will be immediately suspended, and the URLs reported for smishing attacks will be instantly blocked. The phone numbers of healthcare and medical institutions will be registered on the list of No Caller ID Spoofing so that their outbound caller ID of cannot be altered (or manipulated), and the government will keep track of the list (e.g. by sending official notices to the KCDC).

Figure 29 Damage Prevention System

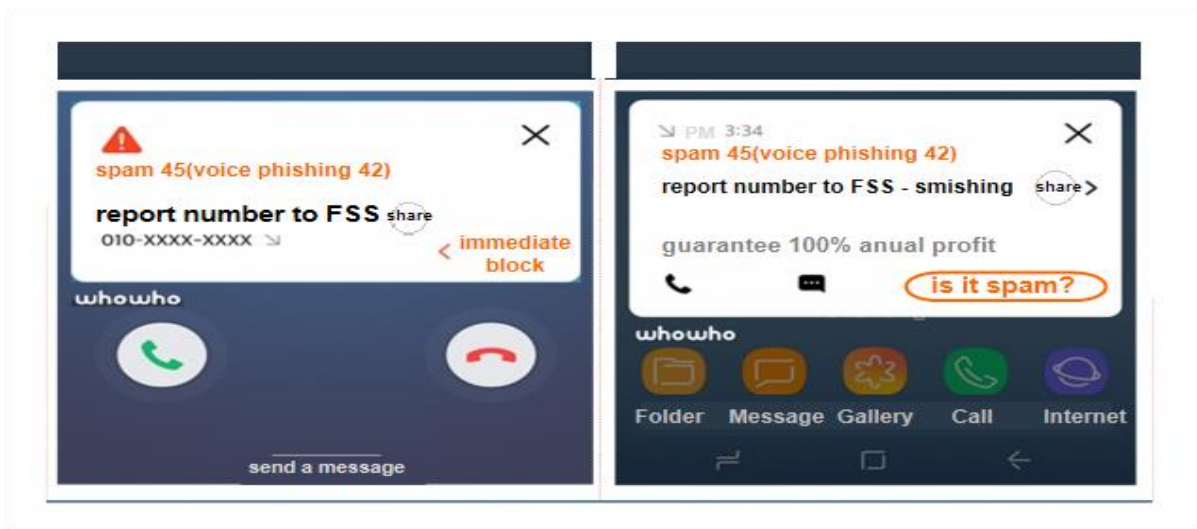


Figure 30 Smishing Precaution by Financial Supervisory Service


**Financial
Supervisory
Service**

Precaution Smishing using fake COVID-19 guidance SMS



- **If you received a suspicious SMS,**
- **Don't click on suspicious telephone number and internet address(URL) in the SMS**

[Normal SMS(example)]

[MOIS] Please maintain enhanced personal hygiene measures, such as wearing a mask and frequently washing your hands to prevent the spread of COVID-19

(Gyeonggi Provincial Office) Please refrain from attending religious events including church services, Buddhist or Catholic services, as well as a variety of other large gatherings (Call #031-120).

[Abnormal SMS(example)]

[Web] Rapid spread of COVID-19. Go to check the identity of confirmed and the contact people news.naver.com_____kr

[Web] a confirmed patient contacted with a large number of people at the rest area http://_pDX Go and check the rest area



- **If you were requested installation of an app,**
- If a malicious app was installed, **account number, personal information may be leaked.**
- **Never enter the password** even if app was installed



- **If you already remitted,**
- **Request immediate suspension of account payment** to the bank(customer center) or police (☎182) or FSS(☎1332)

※ **KCDC(☎1339), HIRA(☎1644-2000) may call or send SMS to prevent the disease, but **hang up** if you were requested **money or installation of an app.****

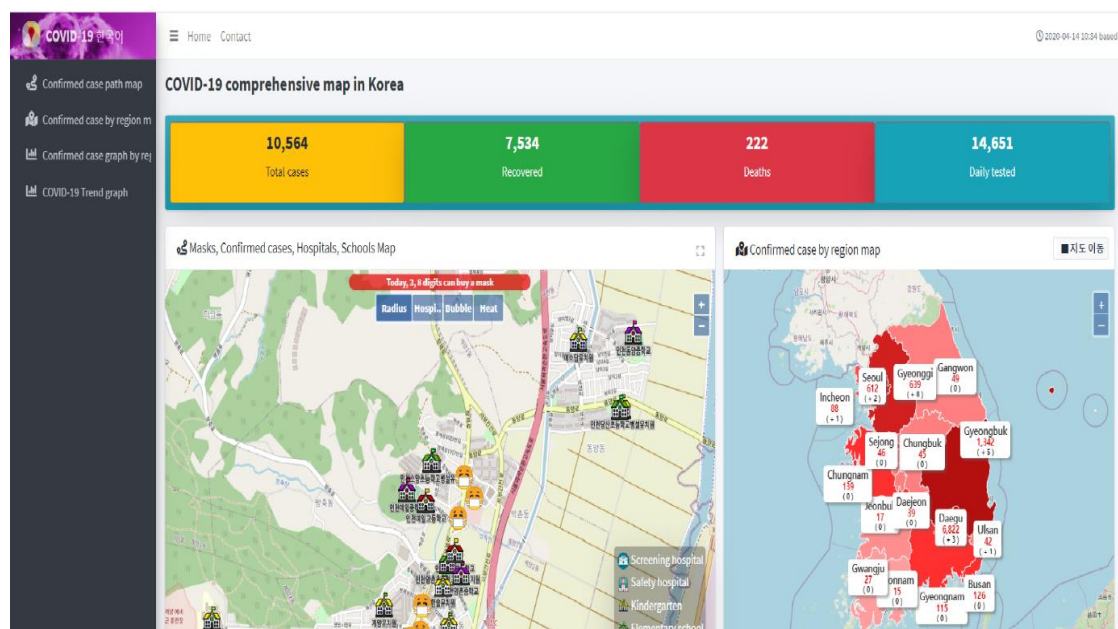
Data : National Police agency

6.6 Innovative Enterprise

(1) In collaboration with other businesses, Company A used Geographic Information System (GIS) in developing a comprehensive situation map for COVID-19 (<https://coronapath.info>), which provides the following 4 types of information in Korean and English.

- A comprehensive situation map marking patient routes, screening centers, COVID-19 safe health clinics, mask vendors, early-voting locations, educational institutions, and places related to Shincheonji
- A map of patient counts for cities and provinces
- A graph of patient counts for cities and provinces
- Graph of COVID-19 situation

Figure 31 Comprehensive Situation Map for COVID-19

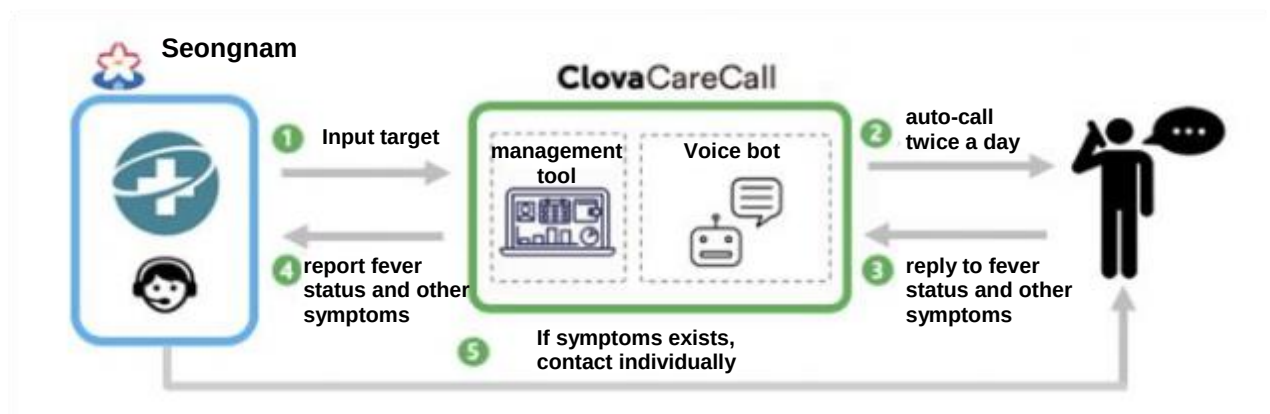


(2) Company B, which develops AI-based software for businesses, utilized disclosed data from the Korea Centers for Disease Control and Prevention and the Ministry of Health and Welfare to provide an AI-base serviced called the COVID-19 Chat Bot, (<http://answerny.ai/corona19.html#>). This service was designed to give the public easy access to accurate information provided by the government. The COVID-19 Chat Bot provides customized information for 1. patients, 2. those under self-quarantine, 3. the general public, 4. medical staff, and 5. group facilities. For example, if someone under self-quarantine asks, 'What should I do under self-quarantine?' it gives the latest guidelines for self-quarantine, instructions for the family or co-habitants, and other relevant information.

(3) The service provided by Clova, an AI platform by Company C, includes calling those under active monitoring in the city of Sungnam twice a day to check whether they have fever or respiratory symptoms and sending the results to the public health clinic via email ('Clova CareCall').

In addition to the Clova CareCall service provided to Sungnam City, the company also provides the general public service through an AI speaker named Clova, which provides information on COVID-19. Clova answers questions such as the current COVID-19 situation, the confirmed cases and number of deaths in and outside the country, prevention guidelines, and mask-related information.

Figure 32 Clova CareCall Service by the city of Sungnam



(4) Companies D and E analyze the media trend and popular searches regarding COVID-19. Company D is affiliated with about 1,800 Korean media companies, and utilizes the traffic data to provide data on media trend and popular articles on COVID-19. Company E analyzes search data on COVID-19 to provide reports on points of inflection, issue points, and relevant searches.

7. CONCLUSION



7. Conclusion

Humanity has usually been at war against each other. But this time, almost every country fight against the same enemy, an invisible micro-pathogen. The success or failure of this fight will naturally be a measure of the overall capacity of a country, and will have great implications for global community and history. We hope this study will be a small but meaningful policy guides for the international community and especially those developing countries by sharing Korea's experiences and countermeasures against COVID-19 over the past three months. COVID-19 countermeasures taken by the Korean government will not be conclusive nor the Korean case cannot be a universal key for all countries' fight against COVID-19. With that in mind, we can have following five lessons from the Korean government's response to COVID-19 using ICT.

First, ICT helps social distancing. Korean government implements number of ICT measures to enhance social distancing. The CBS(cellular broadcasting service) transmits emergency alert text messages on natural or manmade disasters to cell phones through mobile telecom carriers in Korea. It is an effective tool that could help disaster response. Since the coronavirus outbreak, Korean government opened a website to provide information about companies providing solutions for remote working and education and their products. In addition, the government has temporarily permitted doctors to perform telemedicine from the end of February as part of preventive measures to avoid group contagion in vulnerable facilities including medical institutions and nursing homes.

Second, ICT locates COVID-19 with speedy testing. The test-kits for COVID-19 quickly became widely available and played a major role in eliminating uncertainties in the early stages of the viral spread. In Korea, five diagnostic reagent companies have obtained emergency use approval as of now and are producing RT-PCR reagents. Artificial Intelligence (AI) plays a significant role in supporting researchers and healthcare professionals in the diagnosis and screening of patients with severe symptoms, as well as developing appropriate responses based on a thorough analysis of the situation on the COVID-19 spread. In addition, famous "Walk-Thru" testing station allows quick collection of samples as subjects walk through the station with minimal contact.

Third, ICT quickly traces COVID-19. A COVID-19 diagnostic kit was developed by a Korean biotech company using ICT, AI and high-performance computing technology. It quickly became widely available and played a major role in eliminating uncertainties in the early stages of the viral spread. One of the reasons behind Korea's rapid development of diagnostic kits is because companies invest in fostering an R&D environment based on ICT such as big data and AI, which allowed the use of research resources available on global online platforms of the WHO and other international organizations. In addition, AI(artificial intelligence) can quickly learn, recognize, and analyze large-scale data based on high-performance computing resources, enabling more accurate analysis and decision-making. A walk-thru testing station allows quick collection of samples as subjects walk through the station with minimal contact.

Fourth, ICT facilitates COVID-19 treatment. The use of AI is expected to reduce the time required to develop medicine, as AI can learn and make deductions based on the virus and other medical data. One Company, which develops new medicine and relevant platforms through the use of AI, used deep learning algorithms to predict the interaction of drug and protein, and propose candidate medicine for the coronavirus. Another Company and its researchers used pre-trained deep learning-based drug-target interaction model called Molecule Transformer-Drug Target Interaction (MT-DTI) to identify commercially available drugs that could act on viral proteins of SARS-CoV-2. An AI-driven drug discovery start-up using bioinformatics and pharmacogenomics for incurable and rare diseases, has been developing platforms to find candidate substances to treat COVID-19 more efficiently.

Fifth, ICT flattens the curve on COVID-19. Key information such as the accumulated count by region and number of tests performed is summarized and provided as visualization data on the main page of the website. Information on providing overseas travel history, finding COVID-19 screening centers, early-detecting of patients, using epidemiologic surveys and isolating the close contacts of a patient are also provided accordingly. Real-time data of publicly-distributed face masks is provided to people through mobile applications and web services, reducing confusion and inconvenience while raising distribution efficiency.

Finally, we should together make best efforts to turn the crisis into opportunity and make the best use of the cutting- edge ICT technologies in forefront of fight against COVID-19. We should also work together by making every information gathered on COVID-19 readily available to all. Any information on fight against COVID-19 is a public good, and it should be provided quickly to everyone in need and in their fight against COVID-19, as they must act and response most quick and swift manner. In this pandemic we are all connected, any wisdom and experience must be also shared quickly and fairly.

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Annex

1. COVID-19 TIMELINE IN KOREA

Dec 31, 2019	Cluster of cases of pneumonia of unknown origin was reported to China National Health Commission
Jan 3, 2020	Korean government raised the alert level to Blue(level 1 out of 4-level national crisis management system)
Jan 12, 2020	Coronavirus was named 2019-nCoV, and Chinese scientists shared the genetic sequence of the virus internationally.
Jan 20, 2020	First confirmed case of Coronavirus, a 35-year-old female, Chinese national, residing in Wuhan, Hubei province. She was detected with fever upon arrival at Incheon International Airport, and was confirmed positive for coronavirus.
Jan 20, 2020	Korean government raised the national alert level to Yellow (level 2)
Jan 23, 2020	Chinese government locked down Wuhan, the center of the outbreak.
Jan 28, 2020	Korean government raised its infectious disease alert level to Orange (level 3).
Jan 30, 2020	WHO declared the coronavirus a global public health emergency
Jan 31, 2020	COVID-19 test kits based on the virus' genetic code released by China had been distributed to local government labs across Korea.
Feb 4, 2020	Korea began banning entry of all foreign nationals who had been to China's Hubei province in the past two weeks
Feb 7, 2020	COVID-19 test kits became available in private hospitals.
Feb 12, 2020	WHO declared an official name for the new coronavirus - COVID 19
Feb 20, 2020	Number of confirmed cases in Korea reached 100, and first death occurred.
Feb 21, 2020	Korean government declared 'Special Management Region' in Daegu and Cheongdo.
Feb 23, 2020	Korean government raised its infectious disease alert level to Red(level 4) and ordered schools to start the new semester one week later on Mar 9, from Mar 2.
Mar 1, 2020	Korean government divided confirmed patients into four groups and only the sickest and elderly were sent to hospitals. The young and asymptomatic went to dormitories.
Mar 2, 2020	Korean government delayed the start of the new semester to Mar 23.
Mar 4, 2020	Korean government proposed an 11.7 trillion won extra budget bill.
Mar 5, 2020	Korean government declared 'Special Management Region' in Gyeongsan.
Mar 9, 2020	Korean government applied special entry procedures for those from Japan.
Mar 10, 2020	A cluster of confirmed cases appeared in a Seoul call center.
Mar 11, 2020	WHO declared COVID-19 a pandemic
Mar 17, 2020	Korean government delayed the start of the new semester to Apr 6.
Mar 19, 2020	Korean government applied special entry procedures for all foreigners.
Mar 22, 2020	Korean government began implementing stricter rules on social distancing

2. LIST OF PUBLIC HEALTH MEASURES

1. Code of Conduct for the Public	The Korean government is guiding the public to refrain from attending social gatherings and coming into direct contact with others, eat nutritionally balanced meals, ventilate indoor spaces sufficiently, etc. If any signs of a cold are detected, the public is asked to observe their symptoms for three to four days and contact with a public health center or the KCDC call center. If the need arises, they should visit a screening clinic (do not use public transportation). They should go to a COVID-19 protection hospital for respiratory symptoms and use phone counseling service for non-respiratory diseases. Citizens are strongly urged to stay at home, except for essential needs or jobs, with the government restricting religious gatherings, indoor sport activities and attendance at entertainment facilities, such as night clubs and karaoke rooms.
2. Latest Information in a Transparent Manner	Domestic law (Infectious Disease Control and Prevention Act) ensures the public's right to be informed about the latest developments and responses to outbreaks and infection control. The government also mandates the disclosure of the whereabouts, means of transportation, healthcare institutions visited, and contacts of confirmed cases.
3. Mild Cases and Treatment Support Centers	Once public health centers or city- and provincial patient management teams classify patients based on severity (mild, moderate, severe, and extremely severe), all cases excluding mild cases are immediately hospitalized, and mild cases are transferred to living and treatment support centers. Healthcare staff conducts the monitoring of mild cases at least twice a day. If symptoms are aggravated, they are immediately transferred to healthcare institutions. When symptoms are mitigated, they are discharged based on relevant standards (about three weeks).
4. Aggressive Inspections of High-risk Groups such as 'Shincheonji' Religious Group Members	The list of 'Shincheonji' religious group members nationwide was provided to all local governments including Daegu to identify confirmed cases and rapidly conduct tests on those with symptoms. In order to prevent any Daegu residents from being disadvantaged by the testing of 'Shincheonji' religious group members, those with symptoms are advised to undergo diagnostic tests at screening clinics. The government is making door-to-door visits to conduct diagnostic testing for seniors and those with underlying health issues.
5. Hospital Beds and Healthcare Staff	Government offices and hospitals across Korea have offered space and medical services in their areas to solve the shortage of hospital beds and isolation facilities to treat coronavirus patients in Daegu. Moreover, physicians and nurses are being recruited from public hospitals, etc., and dispatched to Daegu on a continual basis.

3. SUMMARY OF ECONOMIC MEASURES AGAINST COVID-19

1. Small- and medium-sized enterprises (SMEs) and Micro-business owners

<u>Fiscal support</u>	<u>Tax relief</u>
• Support programs provided to normalize the operations of affected stores that were visited by confirmed patients • Support for rental fees for micro-business owners (providing a 50% tax relief cut when building owners reduce rental fees for micro-business owner tenants, and rental fees cut for buildings owned by the government and public organizations) • Emergency relief fund for affected SMEs • Provision for maintaining employment and labor costs	• Extending the deadline of filing and paying internal and local tax returns, postponing tax investigations, and applying a grace period for collecting taxes and any arrears • Reducing the tariff for the emergency procurement of key parts via airlines
<u>Financial support</u>	<u>Administrative support and other support</u>
• Expanding lending support (via loans and guarantees) • Underwriting greater level of accounts receivable insurance and lowering insurance premiums • Enlarging the size of P-CBO issuance and relaxing its requirements	• Expediting customs procedures for raw and sub-materials, and helping to identify alternative procurement services • Streamlining importing screenings • Extending contract/delivery periods for goods procured by the government

2. Export Industries

<u>Fiscal support</u>	<u>Tax relief</u>
• Offering exporting vouchers • Helping to establish online exhibitions	• Prolonging the deadline for tariff collections, and allowing payments in installments • Expediting tax refunds • Putting off tariff investigations
<u>Financial support</u>	<u>Administrative support and other support</u>
• Reprieving bankruptcies filed by insolvent exporting companies • Reducing the spread on deferred payments of bills bought in foreign currency • Extending the expiration period of import L/C	• Operating trouble-shooting help centers

3. Local Economy

<u>Fiscal support</u>	<u>Tax relief</u>
• Emergent budget execution in local areas for the first of this year • Issuing additional local gift certificates and offering a larger discount on them • Designating areas for special management such as Daegu and Gyeongbuk Province, and providing special support worth 1.7 trillion won	• Suspending tax investigations in local areas • Helping to pay local taxes in installments and postponing due dates for tax payments
<u>Financial support</u>	<u>Administrative support and other support</u>
• Applying the prime rate on initial lending • Backing local governments and municipalities that are propping up local SMEs (through loans and guarantees)	• Reducing the bidding time period when purchasing masks • Running an on-site center and an inspection force for reporting unfair practices pertaining to sanitary aid and quarantine products

4. Airline and Shipping Industries

<u>Fiscal support</u>	<u>Support for fees and penalties</u>
• Lowering the usage rate of port and airport facilities • Reducing rental fees for passenger terminals	• Extending the deadline for penalty payments newly incurred by airlines • Longer period for reducing fees for Aircraft Certification Systems (ACS)
<u>Financial support</u>	<u>Administrative support/Miscellaneous</u>
• Emergency lending targeting LCCs, passenger ships, and stevedoring companies • Introducing a public guarantee program on operational leases for airlines • Injecting liquidity when companies confirm a reduction in freight or cargo volume	• Postponing the retrieval of unused operation rights/slots, and increasing per-time slots • Distributing operational rights for mid- and long-distances, and helping to open non-service routes • Extending the due date for vessel screenings

5. Tourism, Restaurant and Service Industries

<u>Fiscal support</u>	<u>Tax relief</u>
• Pushing ahead with modernizing facilities including tourism special zones and cultural properties • Easing requirements for subsidies for employment stability • Providing disinfection services to companies that confirmed patients visited	• Cutting asset taxes imposed on accommodative facilities • Extending the due date of patent rights payments from duty free shops and permitting installment payments
<u>Financial support</u>	<u>Administrative support/Miscellaneous</u>
• Temporarily introducing preferential non-collateral financing • Greater coverage for general loans and applying the prime rate to more borrowers	• Helping to address disputes related to cancellations and requesting refunds • Distributing posters explaining tailored responses to dining industries

6. Workers / Consumers

<u>Fiscal support</u>	<u>Tax relief</u>
• Adopting five consumption coupons (for jobs, vacation, cultural events, tourism, and childbirth) • Providing support for living expenses for vulnerable groups • Expanding support for employees suffering from delayed wages • Granting living expenses for the self-quarantined	• Temporary increases in tax relief for the special excise tax and income tax • Putting off the period of value-added tax refunds targeting hotels accommodating foreign tourists • Easing the burden of social security insurance premiums and electricity bills
<u>Financial support</u>	<u>Administrative support and other support</u>
• Strengthening financing for living expenses for job seekers	• Escalating support for costs related to civil litigations for pursuing unpaid wages • Further vocational training for job seekers

4. FREQUENTLY ASKED QUESTIONS (FAQ)

Q (TRACE) What is the criteria for classifying someone as a “contact” (a person who has been in contact with a confirmed case)?

- ☞ The criteria is determined based on an exposure assessment conducted by the Epidemiological Investigation Team. The scope of exposure starts on the day before the confirmed patient started showing symptoms, taking into account the symptoms of the confirmed patient, whether the confirmed patient was wearing a mask, and the risk level of exposure (location of contact, duration of contact, etc.).

Q (TRACE) What happens if you are classified as a contact?

- ☞ You should isolate yourself for 14 days from your last potential exposure. You will receive a self-quarantine notice from the Head of the Health Service, be informed of the self-quarantine guidelines, and be assigned a clerk who will check in with you twice a day to check for fever and other symptoms until you are released from self-quarantine to check for fevers and symptoms.

Q (TRACE) What are the self-quarantine guidelines?

- ☞ First, separate yourself from other people and frequently ventilate rooms by closing the doors and opening the windows. If possible, stay in a place where you can have a separate bathroom and wash basin to yourself.
- ☞ If you use a public bathroom or wash basin, make sure you disinfect the area with bleach or other household disinfectants before other people use them. Use your own personal items, including towels, dishware, and mobile phone. Wash your clothes and bedding separately. Eat alone and make sure to separate your dishware from everyone else's.

Q (TRACE) Is violating a self-quarantine order punishable by law?

- ☞ Failure to cooperate with quarantine orders may result in a criminal penalty (maximum fine of three million won). Upon the promulgation of the Infectious Disease Control and Prevention Act (passed by the National Assembly on February 26, 2020), violations may be penalized by a prison sentence of up to one year or a fine of up to 10 million won.

Q (TRACE) Are living expenses provided during the self-quarantine period?

- ☞ Yes, your expenses will be covered during the self-quarantine period and you will be on paid leave. For details, contact your Community Service Center.

Q (TEST) Who is eligible to get tested?

- ☞ In accordance with KCDC guidelines, patients classified as suspected cases and Patients Under Investigation (PUI) may get testing. There is no need to get tested out of simple anxiety. We ask that you trust the expert advice of your physicians.

Q (TEST) Difference between a suspected case and a Patient Under Investigation?

- ☞ Suspect cases are people with high risks of having been infected after coming into contact with a confirmed case. Although the risk level is not as high as PUIs, people are classified as suspected cases based on their travel history and physician's opinion.
- ☞ PUIs must report their symptoms. Even though an epidemiological survey will not be conducted and a self-quarantine notice will not be issued, Patients Under Investigation must follow the same measures as confirmed patients.

Q (TEST) Where can I get tested?

- ☞ You can get tested at COVID-19 screening centers that are equipped to collect samples. The following link provides a list of COVID-19 screening centers (in Korean) where you can get tested. (Link) http://www.mohw.go.kr/react/popup_200128.html or call the 1339 hotline.

Q (TEST) How is the test performed?

- ☞ Samples are collected by physicians, nurses, and medical technicians at designated locations (COVID-19 screening centers). Nurses and medical technicians will collect samples under the guidance of physicians. Two types of samples are collected, during which you may experience some discomfort/pain.

Q (TEST) How long does it take to get the DNA test results back?

- ☞ You can expect to get your results back one to two days after testing.

5. PUBLIC ANNOUNCEMENT POSTERS ON COVID-19



Recommendations for preventing Medical Institution COVID-19



To Public!

When you visit medical institutions



If you are a **suspected COVID-19 patient**,
use **selected clinic**

*Selected clinic information: Check out KCDC homepage,
Call local Health centers or call 1339 or your area code + 120



If possible, **use your own car**
when visiting **selected clinics**,
and be sure to **wear a mask**
when **using public transportation**



**Avoid contact with others until
you receive the results of the test.**



To Medical Staff!

When respiratory patients visit your medical institution



When you are **treating respiratory patients**,
be sure to **wear masks or other protective gears**



When **suspicious respiratory patients** visit
your medical institution,
conduct screening medical treatment thoroughly
(Ask travel history and use DUR and ITS, etc.)



If your patient is **suspected of
being infected with COVID-19**
report to your local public health center

* For more information about COVID-19, check out: [COVID-19 official homepage ncov.mohw.go.kr](https://ncov.mohw.go.kr)

Date of issue : Feb 17, 2020



질병관리본부
KCDC

2020.3.2.



Guideline for Self-quarantine Patient



Avoid outdoor activities to prevent the transmission of infection

※ If you are in self-quarantine, please cooperate in preventing transmission of infection under "Infectious Disease Control and Prevention Act".

* You could be fined up to 3 million won by the Article 80 (Penalty).



Stay alone in an isolated place

- Keep the door closed and open the window frequently to ventilate.
- Eat by yourself.
- If possible, stay in the place with a bathroom and sink that you can use alone.
(If you share a bathroom and sink, disinfect them after use with a home disinfectant such as chlorine bleach.)



If you need to go out to see physicians or for other inevitable reasons, you must contact the local public health center (the public health officer in charge) first



Avoid contact with family members or cohabiters (speaking, etc.)

- If inevitable, do not face one other, wear masks, and keep your distance at least two meters.



Use personal items (personal towel, utensils, mobile phone, etc.)

- Do not wash your clothes and bedding with others.
- Make sure no one uses your personal items before washing them separately.



Comply with the health guidelines

- Follow personal hygiene practices (washing hands, sanitizing, etc.)
- Wear a mask when coughing.
- If you don't have a mask, cover your mouth and nose with your sleeve when coughing.
- Wash or sanitize hands after coughing or sneezing.

While you are in self-quarantine, your local public health center (the public health officer in charge) will contact you to check your symptoms and conditions
Please monitor and record your symptoms until you are released from quarantine.

How to monitor symptoms

 Take the temperature every morning and evening

 Check your health condition for any symptoms of infection, such as respiratory symptoms, and record them on the monitoring form (Form 6)

 Inform your local public health center (the public health officer in charge) of your temperature and symptoms when they contact you (2 times a day or more)

Major Symptoms of COVID-19

 Fever (over 37.5 °C)

 malaise

 Sore throat

 Respiratory symptoms (cough, difficulty in breathing, etc.)

 Pneumonia



Guidelines for family and cohabiters of a self-quarantined person



Avoid contact with the person who is in self-quarantine as much as possible.

- Contact is strictly prohibited for those with lowered immunity, including seniors, pregnant women, children, sufferers of chronic diseases and cancer, etc.
- Restrict visitors



If you can't avoid being in contact, wear a mask and keep at least 2 meters distance.



Stay in an area independent from self-quarantine area, and ventilate the shared area frequently.



Wash hands frequently using water and soap or hand sanitizer.



Use personal items separately. (tableware, cup, towel, bedding, etc.)

- Wash clothes and bedding of suspected infectee separately from others'
- Separate tableware of suspected infectee, so others don't use it before it is cleaned.



Clean the surface that is frequently touched, such as table top, doorknob, bathroom tools, keyboard, bedside table, etc.



Pay a close attention to the health condition of suspected infectee.

Major Symptoms of COVID-19

-  Fever (over 37.5 °C)
-  Respiratory symptoms (coughing, sore throat, etc.)
-  Pneumonia

2020.02.26



Do you have any question about infectious disease or other diseases?

Don't worry even if you do not speak in Korean.
For more information on disease, **please call at 1339!**



Q. Can foreigners use 1339 Call Center too?

1339 call center is available on interpretation service, cooperation with **1330**(Korea Tourism Organization), **1345**(Immigration Contact Center), etc.

1330 service

24 hours available | Korean, English, Chinese, Japanese

08:00~19:00 | Vietnamese, Thai, Malay, Russian

1345 service

24 hours available | Korean, English, Chinese

09:00~18:00(Weekdays) | 14 languages including Vietnamese, Thai and Japanese

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COVID-19 – Correct methods of wearing a mask

“Wearing a mask can prevent infectious diseases.”

- 1 Wash your hands thoroughly with soap and running water before putting on a mask.
- 2 Place the mask tightly on the face, fully covering your mouth and nose.
- 3 Do not put a towel, tissues, etc. in the mask.
- 4 Do not touch the mask while wearing the mask.
If you do, wash your hands thoroughly with soap and running water.
- 4 Wash your hands with soap and running water after removing the mask, and remove the mask by touching its straps only.

A fold-type mask

- 1  Unfold the mask and round the side edges.
- 2  Ensure its nose wire is facing upwards, fully covering your nose and mouth.
- 3  Put the ear loops around your ears.
- 4  Use both hands to pinch the nose wire around your nose.
- 5  Keep the mask fit tightly on your face, checking air leakage.

A cup-type mask

- 1  Gently hold the mask in your hand, letting the headbands hang downwards.
- 2  Place the mask on your face, covering your nose and chin.
- 3  Pull the top strap over your head and secure it around the crown of your head.
- 4  Pull the bottom strap over your head and secure it on the back of your neck with a holding device.
- 5  Use both hands to pinch the nose wire around your nose.
- 6  Keep the mask fit tightly on your face, checking air leakage.

Source : Correct Methods of Wearing Hygiene Masks by the Ministry of Food and Drug Safety

6. SUPPORT MEASURES FOR REMOTE LEARNING

1. Zero-rating when Accessing EBS and educational websites	On March 16, the Korean government decided to apply zero-rating by exempting certain educational websites* from the data allowance until the end of May. * Digital Textbook, Cyber Learning Space, ScienceAll, Entry (software), CareerNet Starting April 9, students, parents and teachers can access EBS website free of data charges on their smartphones until the end of May, without having to apply for it. * Zero-rating is applied only to the website of EBS; it is not applied when using EBS content on other websites such as YouTube of Naver TV.
2. IPTV and pay TV to provide real-time EBS educational content	Korea's pay TV providers, including the three major IPTV companies (KT, SKB, LGU+), cable TV and satellite TV, are providing real-time educational content such as EBS live lectures for primary and secondary school students on their channels. Students with access to IPTV and other pay TV services can now enjoy EBS lectures at home on a platform of their choice (Internet or TV).
3. 36,000 smart tablets donated to children in low-income families	In response to the shortage of smart tablets prepared by the Korean government and local offices of education for children in low-income families, Samsung Electronics will donate 30,000 tablets (Galaxy Tab A 8.0) in partnership with the Hope Bridge Association of the National Disaster Relief, and LG Electronics will donate 6,000 tablets (G Pad 3 8.0).

7. SIX CYBERSECURITY RULES FOR REMOTE WORKING

For users		For data security managers	
1	Ensure your computer is up to date - When using your computer for remote working, make sure to keep your computer's operating system and applications are up to date	1	Recommend staff to use VPN - Recommend staff to use VPN, following the office cybersecurity policies - If there is no office VPN, update the antivirus software of intranet-connected computers and regularly scan the computers for virus
2	Update your antivirus software and check your computer's security - Update your antivirus software and regularly scan your computer's security for virus (A day before remote working and once every day) - Set automatic updates for your antivirus software and always turn on real-time scanning	2	Develop cybersecurity guidelines for staff working from home and raise their awareness on cyber security - Develop cybersecurity guidelines and provide education on setting computer operating system, applications and antivirus software, setting a router password, and refraining from visiting websites for non-work purposes
3	Set a password for your home router and refrain from using private Wi-Fi or public computer - Update the software of your home router and set a password ※ Include symbols in your password to make it harder to guess - Refrain from using Wi-Fi of restaurants or coffee shops. Refrain from using public computers.	3	Manage user accounts and access level of staff working from home - Advise staff to create a strong password and minimize the levels of access of those working from home - Require a two-step verification when accessing VPN (e.g. password and OTP)
4	Use work e-mail accounts rather than personal ones - Use your work e-mail account provided by your employer - When using your personal account, do not use it for purposes other than work and be careful before clicking a link or running a file ※ You must sign out from your account after reading e-mails on public computers.	4	Automatically log off idle users - Set automatic log-off from intranet for idle users ※ Automatic log-off after 10-30 minutes is recommended
5	Refrain from visiting websites unnecessary for your work - Refrain from visiting websites other than those needed for your work	5	Strong monitoring for log-in and VPN connection - Strong monitoring to see whether staff working from home are logged in or using VPN

6	Be careful when downloading (Beware of ransomware) - When downloading a file from e-mail or web browser, do not download suspicious files because there is a risk of ransomware attacks - Back up work data on a separate storage device on a regular basis	6	Improve cybersecurity for personal and company data (Beware of ransomware) - Develop measures to prevent data breach by adding DRM to important documents ※ e.g. Authorization should be granted when taking company data outside the intranet - Scan for ransomware or virus when importing files from personal computers of staff to intranet - Back up important company data
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