

The Republic of Korea's Digital Tools for Fighting COVID-19



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ABBREVIATIONS & ACRONYMS

AI	Artificial Intelligence
API	Application Programming Interface
CBS	Cellular Broadcasting Service
CCTV	Closed-Circuit Television
CDCHQ	Central Disease Control Headquarters
CDMHQ	Central Disaster Management Headquarters
CDSCHQ	Central Disaster and Safety Countermeasures Headquarters
COVAX	COVID-19 Vaccines Global Access
CT	Computed Tomography
DEAP	Digital Empowered Agile Progressive
EHR	Electronic Health Record
EISS	Epidemiological Investigation Support System
EOC	Emergency Operations Center
ICT	Information and Communications Technology
ICU	Intensive Care Unit
IDCC	Infectious Disease Control Centers
IoT	Internet of Things
KCDC	Korean Center for Disease Control and Prevention
KDCA	Korean Disease Control and Prevention Agency
KNPA	Korean National Police Agency
KPIs	Key Performance Indicators
LDSCHQ	Local Disaster and Safety Countermeasures Headquarters
MERS	Middle East Respiratory Syndrome
MOHW	Ministry of Health and Welfare
MOIS	Ministry of Interior and Safety
NEIS	National Health Insurance Eligibility Inquiry System
NHIS	National Health Insurance Service
NIA	National Information Society Agency
NIS	National Intelligence Service
OECD	Organisation for Economic Co-operation and Development
PCSHQ	Pan-governmental Countermeasures Support Headquarters
RTCs	Residential Treatment Centers
SARS	Severe Acute Respiratory Syndrome
SNUBH	Seoul National University Bundang Hospital



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EXECUTIVE SUMMARY

The Republic of Korea's response to COVID-19 has been exemplary, especially during the early stages of the pandemic when the government was able to quickly mitigate the spread of infections and prevent health care services from becoming overwhelmed. As a result, Korea had a particularly low number of total cases and deaths from COVID-19 in 2020 and 2021. The success was due to strong leadership in a pan-governmental approach that implemented preventive public health measures while trying to keep the economy as open as possible. This approach involved the 3T strategy (Testing, Tracing, Treatment) and a four-pillar policy response centered on Openness, Transparency, Civic Engagement, and Innovativeness. The strategies and policies implemented are key to studying Korea's public health emergency response process, as is the significant role of information and communications technology (ICT) tools. In addition, Korea's highly advanced health care digitalization also played an important part in patient management and treatment, and the overall penetration of digital tools helped the population adopt ICTs for responding to the emergency.

Following the previous infectious disease outbreaks, Korea addressed the shortfalls in its public health emergency response system. A principally important change was the establishment of the Korean Center for Disease Control and Prevention (KCDC, now the Korean Disease Control and Prevention Agency [KDCA]) in 2004. The KCDC established new legislation, namely the Infectious Disease Control and Prevention Act that paved the way for the pan-governmental COVID-19 response and civic engagement in it. The response also required monitoring of several key performance indicators (KPIs) to evaluate the country's success with its implemented preventive measures and gradually manage transitions back to pre-COVID-19 routines. With these data, timely changes have been applied to correct identified mistakes in the COVID-19 response and strengthen weak points.

That said, these changes are also due the sophisticated ICT tools that process data to facilitate the response to COVID. Most of these tools were not available during previous public health emergencies. Korea's tools are particularly advanced, so although some of them may require a significantly advanced technological infrastructure and considerable investments, many others could be easily adopted and implemented in countries with more average digital development levels to improve their public health emergency response systems. Based on WHO's [classification of digital health interventions](#) (WHO, 2018a), the digital tools that were used specifically for the response **have been divided into three categories: communication, monitoring and surveillance, and supporting provision for health services.**

Digital tools for communication comprise the channels used by the government to communicate internally and externally, coordinate the COVID-19 response, and keep citizens involved and up to date with the latest developments. The government has been using an internal web-based system allowing immediate communication and situation updates, which helps accelerate the decision-making process, resource mobilization, and overall response coordination. Communication tools to update the public with official information on the latest developments are also crucial for a successful response. In the case of Korea, these include daily TV broadcast situation reports, the creation of an official government website for COVID-19 information, and the creation of a hotline. Other communication tools have also been implemented such as the Safety e-Reporting System, which allows the public to report any violations to the preventive measures and suggest changes to the policies. Local ICT companies have also contributed by creating apps to make information more easily accessible to the public, such as the location of screening stations, high-risk zones, and availability of face masks in pharmacies.

Digital tools for monitoring and surveillance include those used for contact tracing, epidemiological investigations, and quarantine verification and monitoring. Korea has pioneered the use of digital tools particularly for contact tracing with the development of the Epidemiological Investigation Support System (EISS), which tracks the detailed movements of confirmed cases, but also using AI systems for symptom monitoring, and the Self-Quarantine Safety Protection App to monitor cases in isolation. These systems have caused some controversy due to the invasion of privacy but have also accelerated the capacities of the system to identify and isolate close contacts of confirmed cases.

Digital tools that support the provision of health services facilitate the work of health care personnel and also protect them and other patients vulnerable to nosocomial infections. These tools include telemedicine consultations, web-based patient managing systems, and AI symptom monitoring systems that can be installed in hospitals to ease the burden of health care personnel, for example. Korea does not permit the practice of telemedicine because of the risk of misdiagnoses and other concerns; however, it has been implemented during the emergency to provide easier access to health care service and to reduce risk of transmission. Moreover, Korea's health care system was already advanced in terms of digitalization, which not only eases the medical personnel's workload, but also protects them by reducing the need of being in direct contact with the patient due to remote monitoring systems.

Korea's COVID-19 response can be used to guide improvements to emergency preparedness and response systems around the world—especially in terms of the ICT tools that have been vital in communications, prevention, surveillance, and treatment. The socioeconomic context and digital readiness of a country's system is a critical factor for assessing the feasibility and probability of success of implementing digital tools. While we recognize that there have been many studies of the experience of Korea during COVID, this case study identifies the main ICT tools used in the Korean response and establishes a preliminary classification by importance as well as challenges to implementation, which may vary by country, to help other countries build more comprehensive public health emergency responses.





1.

INTRODUCTION



1. INTRODUCTION

Korea is an economic powerhouse in electronics and ICT, and the corresponding increase in technological infrastructure and investment has driven a rapid expansion in the digitalization of health care, including innovative uses of medical technologies such as big data, telemedicine, genomics, mobile applications, wearable devices, IoT, AI, and other ICTs. Korea is also a leader in terms of digital development and penetration.

As of 2021, an estimated 97 percent of Koreans regularly use the internet and 89 percent are active on social media, and there are 60.6 million active mobile connections, corresponding to 118 percent of the population (Kemp, 2021).

This solid ICT infrastructure is a contributing factor to Korea's success in managing the pandemic, as the government took advantage of its digital tools to mitigate disease spread, particularly for implementing its 3T (Testing, Tracing, Treatment) strategy. This wide adoption of digital services also strengthened pandemic preparedness by enabling rapid and transparent information sharing related to disease incidence level, policy updates, and essential resource distribution, such as masks and vaccines.

That said, regulatory barriers, especially regarding telemedicine and data sharing, have hindered investments and developments in digital medicine (Intralink, 2019). Strict regulations for data sharing are specified in the Personal Information Protection Act, which regulates the handling of personal information that can be used to identify a person (name, address, voice, etc.). However, the Infectious Disease Control and Prevention Act can override these regulations, allowing the

automatic collection and sharing of data (only among relevant authorities) in the case of a public health emergency, such as COVID-19, for contact-tracing purposes and case management.

The government has indicated it may further deregulate digital health to further incentivize its development. For example, clear standards for de-identification of personal information have been introduced, as has a process for shorter approval times of new medical devices based on big data and AI (Intralink, 2020). Similarly, the MOHW has allowed the emergency use of telemedicine during the pandemic to support health service providers and limit COVID-19 transmission even though telemedicine is not permitted in Korea under the Medical Service Act (which ensures that all citizens have access to high-quality medical treatment as a means to protect and improve public health). The Korean Medical Association argues that telemedicine can lead to misdiagnoses, and it could jeopardize the operation of smaller clinics and health centers (Jones, 2020; Shin and Yu, 2021). In June of 2023 the threat level was lowered, making telemedicine illegal again, however as of November 2023, the MOHW is currently implementing a telemedicine pilot to pave the way for the legalization of telemedicine in the country.

This case study discusses the ICT tools used for Korean emergency preparedness and response to COVID-19. [Section 2](#) provides an overview of Korea's public health emergency response framework, with a look at the government and civil society actors involved in emergency protocols. [Section 3](#) details the digital tools mobilized as part of the emergency response during the COVID-19 pandemic. [Section 4](#) concludes with recommendations for countries building an ICT infrastructure, based on lessons Korea has learned in implementing its ICT and public health emergency response management infrastructures.



2.

THE COVID-19 RESPONSE FRAMEWORK



3. THE COVID-19 RESPONSE FRAMEWORK

Korea's response to COVID-19 was highly influenced by the lessons it learned in the 2003 SARS, the 2009 H1N1, and—especially—the 2015 MERS outbreaks.

After the SARS outbreak, the KCDC was created in 2004 (Task Force for Tackling COVID-19, 2020) to monitor and prevent infectious disease spread and provide emergency response strategies in the event of an outbreak. Then, in the H1N1 outbreak, the government recognized the importance of R&D investments in vaccines, cures, and diagnostic devices, so it began managing interdepartmental R&D projects in these areas.

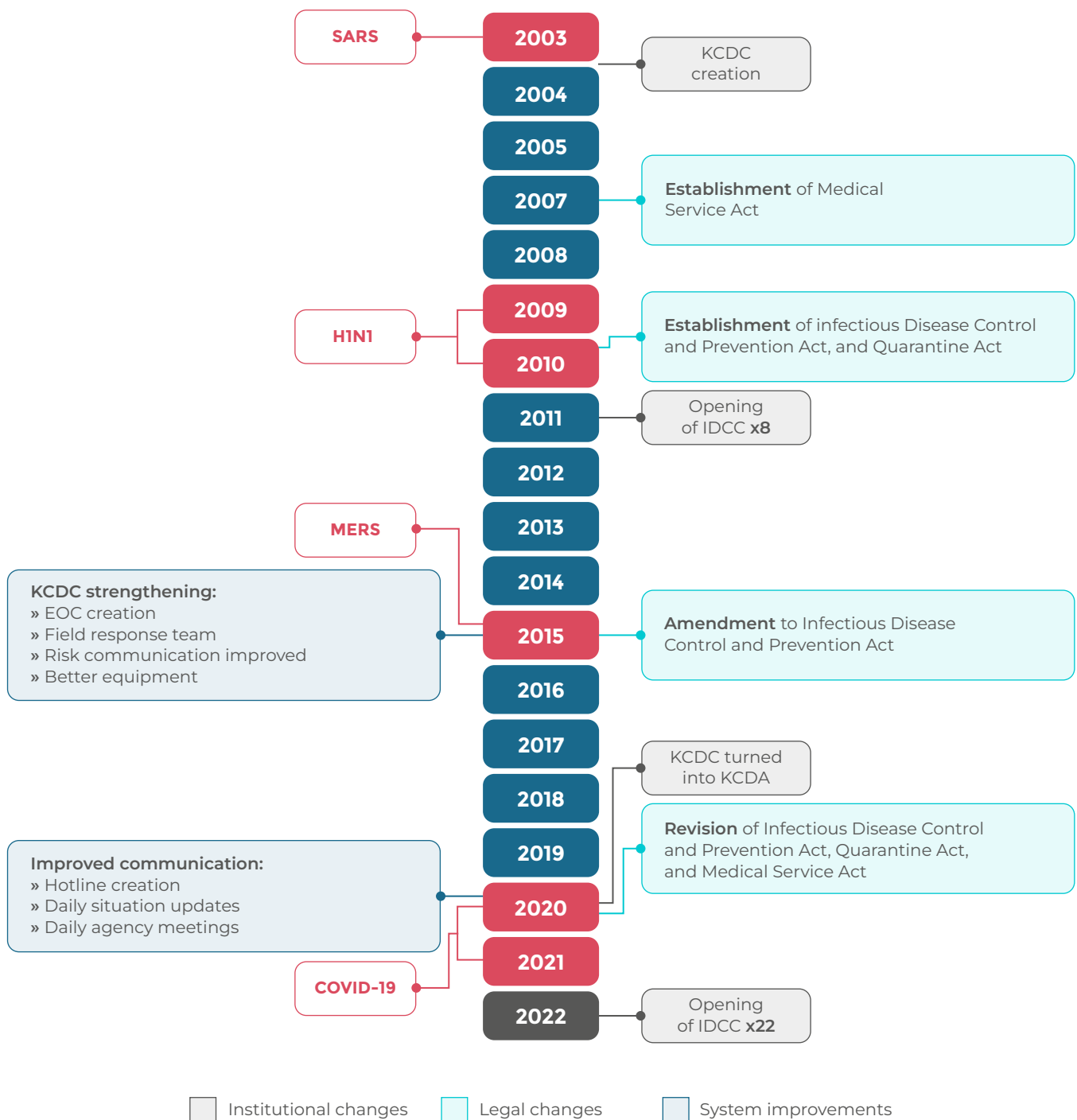
During the 2015 MERS epidemic, the governmental response was widely criticized for lacking transparency. To prevent the public from panicking about MERS, the government had withheld which hospitals were affected by the virus, which resulted in increased transmission within the affected hospitals (OECD, 2020b). In response, the public health emergency response system was updated to boost interagency cooperation and relevant technologies. Notably, the KCDC initiated its risk communications department and

24-hour Emergency Operations Center (EOC), which collects data, monitors disease incidence, receives reports, and provides immediate responses to public health emergencies.

In September 2020, amid the COVID-19 pandemic, the KCDC was upgraded into the KDCA. The staff size increased by 42 percent, and the agency gained autonomy in its management and allocation of resources to expedite decision making and reaction time in emergency response (Song, 2020).



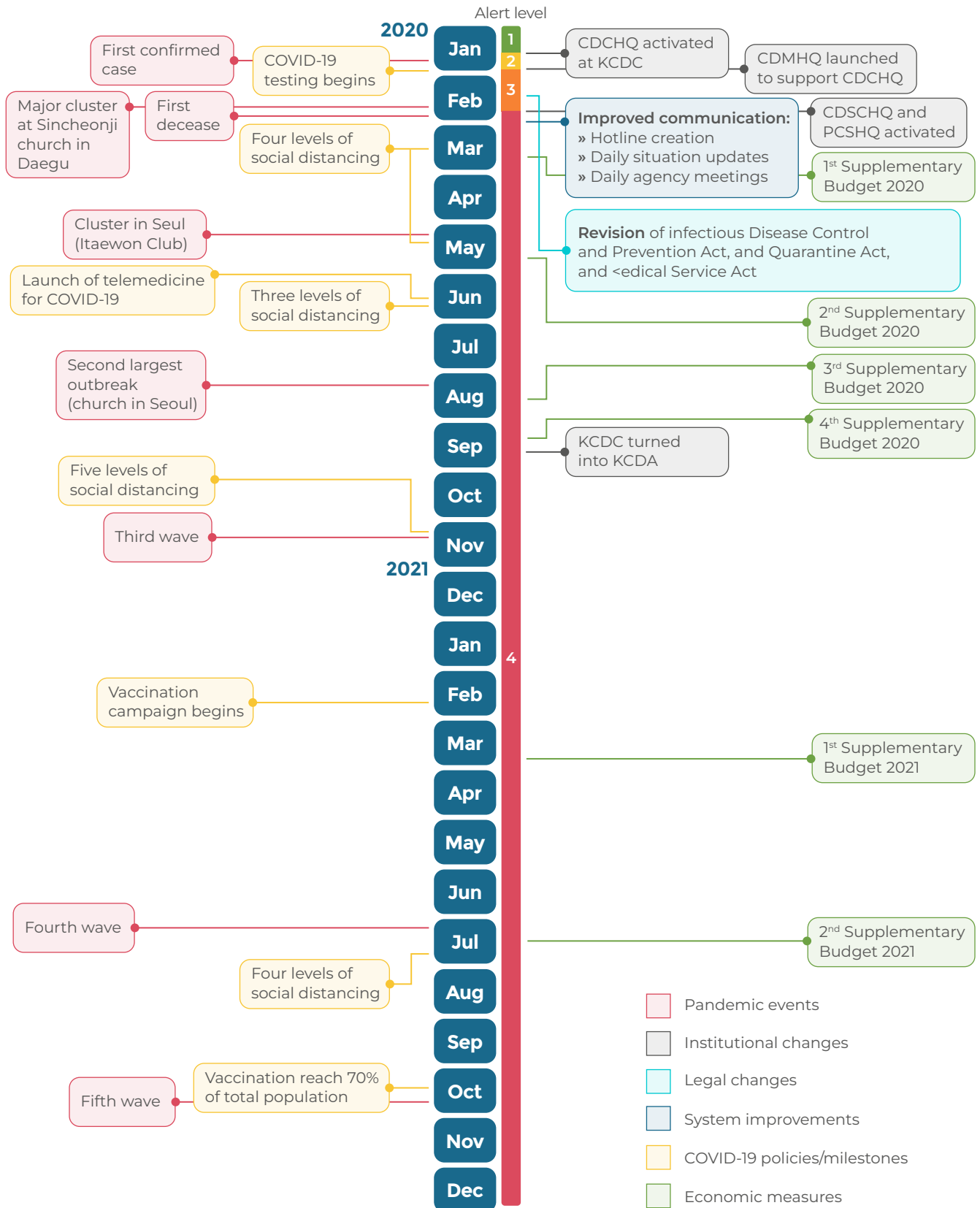
FIGURE 1:
The Evolution of Korea's Public Health Emergency Response System



Source: Own elaboration.

Notes: IDCC = Infectious Disease Control Centers, which were created by the government to strengthen and develop infectious disease expertise.

**FIGURE 2:
COVID-19 Timeline in Korea**



Source: Own elaboration.



Note: The yellow boxes discuss the implementation of social distancing measures for context but they are beyond the scope of this paper.

2.1. The 3Ts and Four Pillars of the Response Strategy

To respond to COVID-19, the government implemented its 3T (Testing, Tracing, and Treatment) strategy.

Korea pushed for the quick development of testing kits from the onset of the pandemic, and this resulted in the first commercial kits being available on February 4, 2020, only a couple of weeks after the first reported case in Korea. Widespread testing was initiated to identify and isolate the infected. Tracing of positive cases was then conducted through the EISS, a platform that handles big data related to tracing, using mobile phone signals, credit card transactions, and CCTV to trace the movements of confirmed cases for up to two days before the onset of their symptoms. Thus, close contacts who may have become infected were identified and notified by a message to their phones of the need to enter preventive quarantine. The local population was likewise identified of potential risk zones to be avoided. Confirmed patients were classified in a triage system depending on their symptoms: to prevent overwhelming hospitals, only patients with severe symptoms were admitted, ensuring that they received Treatment. Mild and asymptomatic cases were sent to residential treatment centers (RTCs), which, in some cases, were repurposed facilities such as corporate dormitories that companies offered for temporary use. With these less severe cases isolated, it was possible to closely monitor patients' symptoms and quickly transfer anyone with worsening symptoms to a hospital (Intralink, 2020; Kemp, 2021).

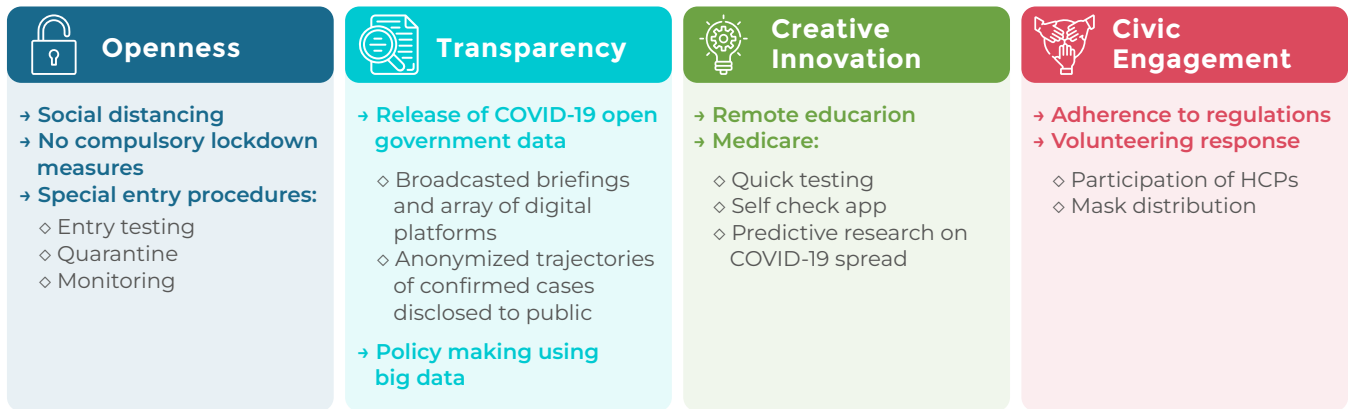
In addition to the 3Ts strategy, the Korean response follows four main principles (Figure 3), laid out in the [Framework Act on the Management of Disasters and Safety](#), that are designed to gain public trust and buy-in while supporting the economy:

-  Openness
-  Transparency
-  Creative innovation
-  Civic Engagement

Openness keeps Korea's borders and society open, without imposing a complete entry ban or mandatory lockdown, by applying the 3Ts strategy. **Transparency** ensures the full and prompt disclosure of data to all government agencies and the public on global and domestic COVID-19 trends, including information about government decisions and strategies. **Creative Innovation** involves creative problem-solving (such as apps to help people find face masks and check for COVID symptoms) and resilient and flexible responses (such as remote education and telemedicine). **Civic Engagement** focuses on gaining citizens' buy-in through clear communications and using public feedback to improve public services. For example, public software developers used sales data released by the government to develop an app that shows the public where masks can be purchased and the current number in stock (Ministry of Food and Drug Safety, 2020). [Section 3](#) describes the digital tools used for each of the four pillars.



FIGURE 3:
The Four-Pillar Policy Strategy for Economic Resilience and Public Health during the Pandemic



Source: Authors' elaboration.

2.2. Governance and Pan-governmental Risk Management

Korea has adopted a pan-governmental response against COVID-19, actively involving all applicable ministries, agencies, and local governments. The response follows measures set out in two pieces of critical legislation. First, the [Framework Act on the Management of Disasters and Safety](#), enacted in March 2004 and amended many times since, details the protocols and different governmental responsibilities in general

for emergencies. Second, the [Infectious Disease Control and Prevention Act](#), established in 2010 after H1N1, specifies these responsibilities for infectious disease management and responding to outbreaks. The acts also address special emergency measures, such as the close monitoring and tracing of any infected citizen by the government through mobile phone signal, CCTV, and credit card transactions (Intralink, 2019; Kemp, 2021).

Korea follows a four-level risk alert system, detailed in [Table 1](#), that classifies an epidemic in terms of infection spread. As the risk level increases, the emergency response effort grows in complexity.



TABLE 1:
The Four-Level Risk Alert Level System

Alert level	Overseas emergence of a novel infectious disease	Domestic unknown/reemerging infectious disease	Responses
Level 1	Overseas emergence of an epidemic caused by unknown infectious disease	Emergence of a domestically unknown/reemerging infectious disease	<ul style="list-style-type: none"> → Surveillance of potential health risks → Preparation of response system → Deployment of on-site measures and infrastructure can begin
Level 2	Novel infectious disease enters Korea	Limited transmission of the unknown/reemerging domestic infectious disease	<ul style="list-style-type: none"> → Activation of agencies' cooperation protocols → Installation of on-site measures and activation of relevant infrastructure → Tracing and surveillance systems strengthening
Level 3	Limited transmission of the foreign infectious disease	Community-wide transmission of the local infectious disease	<ul style="list-style-type: none"> → Strengthening of cooperation between relevant agencies → Enhancement of prevention, monitoring, and surveillance systems
Level 4	Community wide spread of foreign infectious disease	Nationwide spread of local infectious disease	<ul style="list-style-type: none"> → Completion of pan-governmental response → Additional enhancements of prevention, monitoring, and surveillance systems

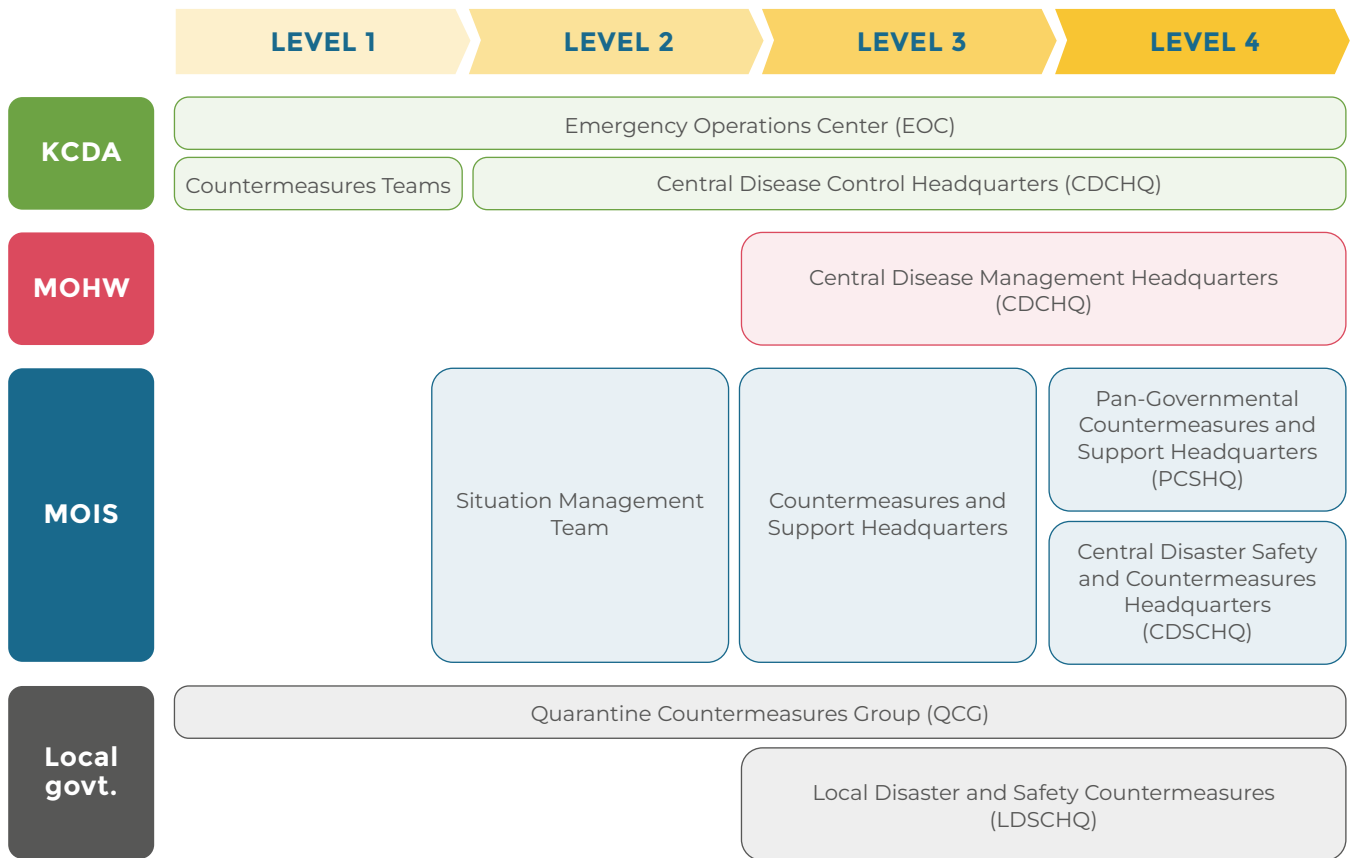
Source: Korea Institute for Health and Social Affairs. 2020. Assessment on COVID-19 Response, Analysis and Evaluation. Seoul.

The KDCA is the primary coordinating agency for all infectious-disease response efforts regardless of the risk alert level (Figure 4). For **Level 1** risks, countermeasures teams are organized at the KDCA according to the type of infectious disease. When an emergency reaches **Level 2**, the Central Disease Control Headquarters (CDCHQ) is launched within the KDCA to manage the situation and focusing on stopping disease spread.

For a **Level 3** emergency and higher, the MOHW launches the Central Disaster Management Headquarters (CDMHQ), which supports the CDCHQ in

managing and mitigating the spread of the disease. Local governments launch their Local Disaster and Safety Countermeasures Headquarters (LDSCHQs), which are headed by the local governor of each province and tasked with implementing the policies and executing the plans mandated by the KDCA. When needed, the central government provides additional support through CDCHQ, CDMHQ, or the Pan-governmental Countermeasures and Support Headquarters (PCSHQ), which coordinates the efforts related agencies, such as the Korean National Police Agency or the National Fire Agency, and local governments.

FIGURE 4:
Government Bodies Activated per Risk Alert Level



Source: Authors' elaboration based on Eurasia Group 2020.

Once a **Level 4** emergency is reached, such as the COVID-19 emergency, the Ministry of Interior and Safety (MOIS) launches the Central Disaster and Safety Countermeasures Headquarters (CDSCHQ). The CDSCHQ is tasked with the overall organization and coordination of the response, and in the most serious emergencies like COVID-19, the CDSCHQ can be headed by the prime minister, who also presides over daily pan-governmental

meetings—all ministries and local government heads are required to attend—that feature situation updates and determinations on the course of action. Given the severity of the COVID-19 emergency, the daily meetings have been conducted through videocalls to ensure that there is no risk of transmission among participants, but also to facilitate immediate communication throughout the whole country.

2.3. Civil Society and Public-Private Partnerships

Although they are not a formalized part of the public health emergency response system, civil society actors and public-private partnerships stepped up and proved crucial to the COVID-19 response. The altruistic creation of apps by private companies and even small startups to map the location of screening stations, high-risk zones, and availability of face masks, as well as the online reporting of violations through the Safety e-reporting online platform, played a part in containing COVID-19. Koreans' high smartphone penetration and internet usage contributed to the adoption of the ICT solutions implemented—many of which are mobile apps or internet

resources that require people's active involvement to generate an impact. Similarly, domestic ICT companies such as Samsung, Hancorn, and Naver provided teleworking services and productivity platforms that facilitated other companies' transition to home-office work (Southerton, 2020).

Public-private partnerships with search engine-based technology and communication companies, such as Naver and Daum, also played a crucial role in efficient communications and resource mobilization. For example, Naver's app allows people to diagnose potential COVID-19 symptoms and arrange home delivery of medications, and Daum's KakaoTalk messaging app helps people find the nearest official sale point of masks, testing stations, and clinics or other facilities with COVID-19 related medical services.





3.

THE DIGITAL TOOLS DEPLOYED AGAINST COVID-19



3. THE DIGITAL TOOLS DEPLOYED AGAINST COVID-19

One difference in Korea's emergency response efforts between the COVID-19 pandemic and previous infectious disease outbreaks is the availability of sophisticated ICT tools to facilitate the 3T strategy and the wider emergency response.

It is important to note that even though some of the tools discussed in this section—particularly the EISS—require an advanced technological infrastructure (cloud and telecommunications infrastructure, programming experts, epidemiologists, etc.), many others could be adopted and implemented in other countries with lower infrastructure levels.

[Table 2](#) introduces the digital tools discussed in this section of the paper, which have been divided into three categories: communication ([section 3.1](#)), monitoring and surveillance ([section 3.2](#)), and support for health services ([section 3.3](#)). The tools can also be classified into the WHO's (2018b) classification of [epidemic and response intervention phases](#): anticipation, early detection, containment, control and mitigation, and elimination or eradication. **The majority of the tools discussed fall into the control and mitigation phase, but computer-simulated outbreak exercises fall under anticipation, and R&D for the development of test kits falls under early detection.**

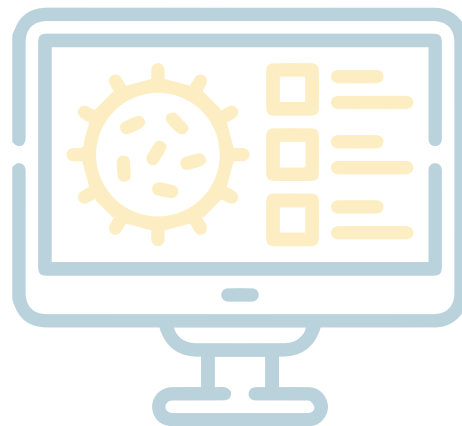


TABLE 2:
ICT Tools in Korea's Response to COVID-19

Classification	Tool name	Tool purpose
Communication	Open public data apps	Information sharing
	Cellular Broadcasting Service (CBS)	
	National Disaster Management System (Korea SafeNet)	Government coordination
	Safety e-reporting system	Violation reporting
Monitoring and surveillance	ICT R&D	Development of diagnosis kits
	Self-Diagnosis App	Self-evaluation of symptoms
	Hancom AI Check 25	AI-based call center and monitoring
	Self-Quarantine Safety Protection App	Quarantine compliance and symptom monitoring
	EISS	Identification, tracking, and mapping movements of infected people
	Korea Internet Pass (KI-PASS)	Tracing: recording visitors to buildings
Supporting health services	ICT (computer-simulated outbreak)	Training public health specialists
	Lunit INSIGHT CXR	Optimizing X-ray and CT scans
	Online vaccination registry and vaccination passport	Vaccination management
	Telemedicine consultations	Reducing risk of infection
	Electronic health records, BESTCare, and other digital patient management systems	Monitoring of patients in hospitals and RTCs

Source: Authors' elaboration.

3.1. Digital Communication Tools



3.1.1. Cellular Broadcasting Service for Emergency and Disaster Alerts

The Cellular Broadcasting Service (CBS) platform was developed in 2005 to send urgent text alerts to the public through cell phones in disaster situations (weather, earthquake, tsunami, traffic, wildfire, accident, etc.). The CBS is based on SMS but has different features, as shown in Table 3. It is linked to MOIS's National Disaster

Management System and government departments and agencies through the government's intranet.

The CBS broadcasts disaster information in short sentences (up to 90 Korean characters) at three alert levels: urgent emergency and disaster alert, emergency and disaster alert, and safety information alert. Each message is often accompanied by short emergency response guidelines. The items broadcast during the COVID-19 pandemic have been status reports on confirmed patients and high-risk zones in residential areas, as well as local information on rapid testing and vaccination and urgent messages from the head of

TABLE 3:
Comparing the CBS with SMS

CBS (Cellular Broadcasting Service)	SMS (Short Message Service)
Point to Multipoint (Simultaneous Multi-broadcasting)	Point to Point (Individual Polling Method)
<ul style="list-style-type: none"> → Simultaneous transmission to all subscribers within the base station provides real-time information regardless of the number of recipients → Little cost is needed for transmitting information; no need to develop a telephone number database; and optional transmission – to local base station coverage area or the whole nation → Large capacity of up to 230 characters per transmission 	<ul style="list-style-type: none"> → The more targets, the longer it takes, from minutes to hours; real-time transmission unavailable to more than 300,000 people → Individual transmission costs are high (₩25–₩30 per person), and transmission is available only to phone numbers already included in the database → Limited capacity of approximately 40 characters per transmission

Source: Disaster Information Transfer System Using Advanced IT; National Fire Agency.

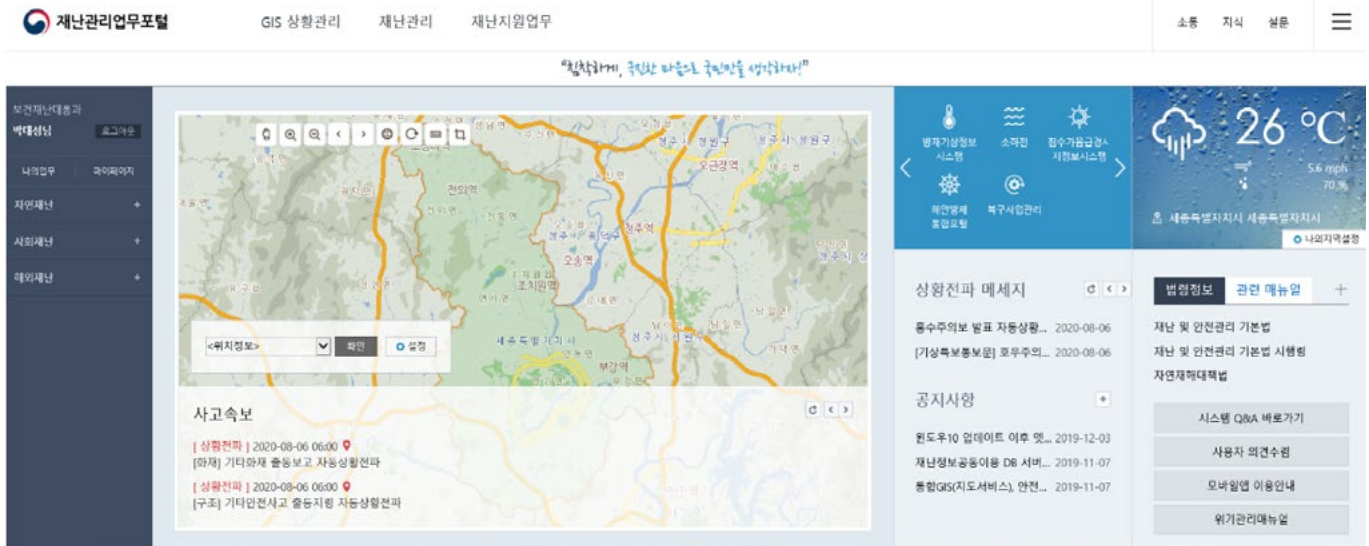
the local government to the residents. Additionally, the CBS was used to inform people identified by the KDCA as a close contact to a confirmed case that they had to enter preventive quarantine until they were tested.



3.1.2. National Disaster Management System, Korea SafeNet

Korean experts have noted that the government has been using the National Disaster Management System called Korea SafeNet, which is an internal web-based system to communicate (Figure 5). The system provides immediate communication with and situation updates from all areas of the country. This instant information access accelerates decision making, resource mobilization, and overall response coordination. Korea SafeNet integrates 11 previous systems into one, with information from 16 ministries gathered in a centralized platform. The platform uses a 3D geo-spatial system to make information of any type of disaster easily available for all government bodies (MOIS, n.d.).

FIGURE 5:
The Korea SafeNet Interface

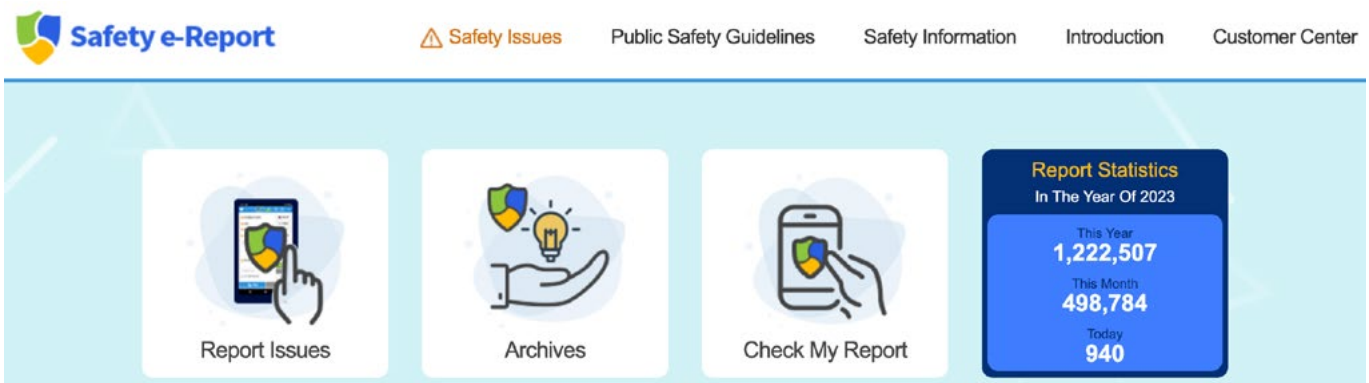


3.1.3. Safety e-Reporting System

One tool that gives particular importance to civic participation in emergency response is the Safety e-Reporting System (Figure 6), which is an online platform where any citizen can report any safety concern to any government ministry.

During the Pandemic, the system was expanded to include COVID-19 related issues. Citizens can access the platform (www.safetyreport.go.kr), report quarantine or social distancing violations, and even propose changes to regulatory policies. The relevant ministry will then investigate and resolve the issue. Apart from COVID-19-related reports, people can report issues related to road safety, school safety, ocean safety, daily safety, social safety, workplace safety, and others.

FIGURE 6:
Screenshot from the Safety e-Reporting System Platform



Source: <https://www.safetyreport.go.kr/eng/#main>.



3.1.4. Open Public Data Apps That Link Citizens with Supplies and Services

Several domestic ICT companies, such as Naver and Kakao (Figure 7), and even small start-ups have created apps to make information more readily available to the population. With official government data available through Korea's open data policies (UN-ESCAP/APCICT, 2020), developers can map important information in a more easily accessible format for the population (Appcues, n.d.; Ministry of Science and ICT, 2020).

For example, early in the COVID-19 outbreak, the government implemented a five-day rotation

mask distribution system that allowed each citizen to purchase two masks on a specified day from a designated store, such as a pharmacy. The measure was meant to ease the shortage of masks, stabilize prices, and ensure equitable distribution. But when masks were out of stock, people had to go in search of them, which compromised prevention measures. As a result, the government converted public data from over 20,000 pharmacies and other face mask stocks into an open application programming interface (API) via the National Information Society Agency (NIA). Private developers responded by launching more than 150 apps and web services connecting people to mask retailers. **In three weeks, these apps and web services fielded 670 million API calls and resolved the mask inventory issue.**

FIGURE 7:
KakaoMap's Pharmacy Locator

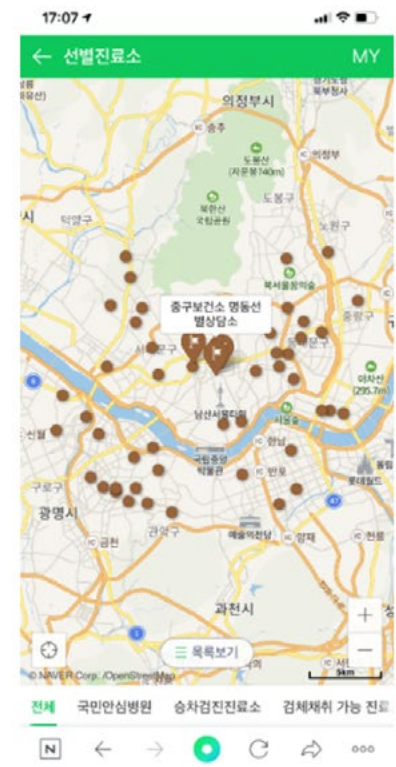
Panel a.
Face mask availability



Panel b.
Naver's pharmacy locator
(shows face mask availability)



Panel c.
Naver's screening station locator



Source: ITU (2020).

FIGURE 8: Apps Created from Open Public Data

Panel a. Naver



Information on COVID-19 screening stations

Panel b. Goodoc



Goodoc's automated hospital reception service

Source: Naver and goodoc's websites.

Similar examples of public data utilization are the COVID-19 screening station inquiry service and the Goodoc app (Figure 8). The former discloses important information on designated national safe hospitals, drive-through screening stations, sample extraction kits, and contact information for people suspected of COVID-19. The latter is a mobile app developed by CARELABS¹ to reserve hospital beds and conduct patient intake online. While the number of confirmed cases grew in early March 2020, Goodoc improved its services, for example, to allow for automated patient intake, provide the route for confirmed patients' transfers, and offer telemedicine support services.

3.2. Monitoring and Surveillance Tools

As soon as the first case was reported in Korea (January 20, 2020), the Ministry of Science and ICT began working on epidemiological models and simulations based on evidence from the pandemic to attempt to predict the development of the situation under different scenarios and plan accordingly in each case (Ministry of Science and ICT, 2020). Digital tools for monitoring and surveillance include those used for epidemiological investigations (sections 3.2.1–3.2.2); quarantine verification and monitoring (sections 3.2.3–3.2.5); contact tracing (sections 3.2.6–3.2.7); and the use of AI systems for symptom monitoring, as discussed in section 3.2.7 as well as in health care provision tools in section 3.3.

¹ CARELABS is a private company that operates a comprehensive healthcare-related IT platform business including hospital information service, hospital customer management software, and digital marketing solutions.

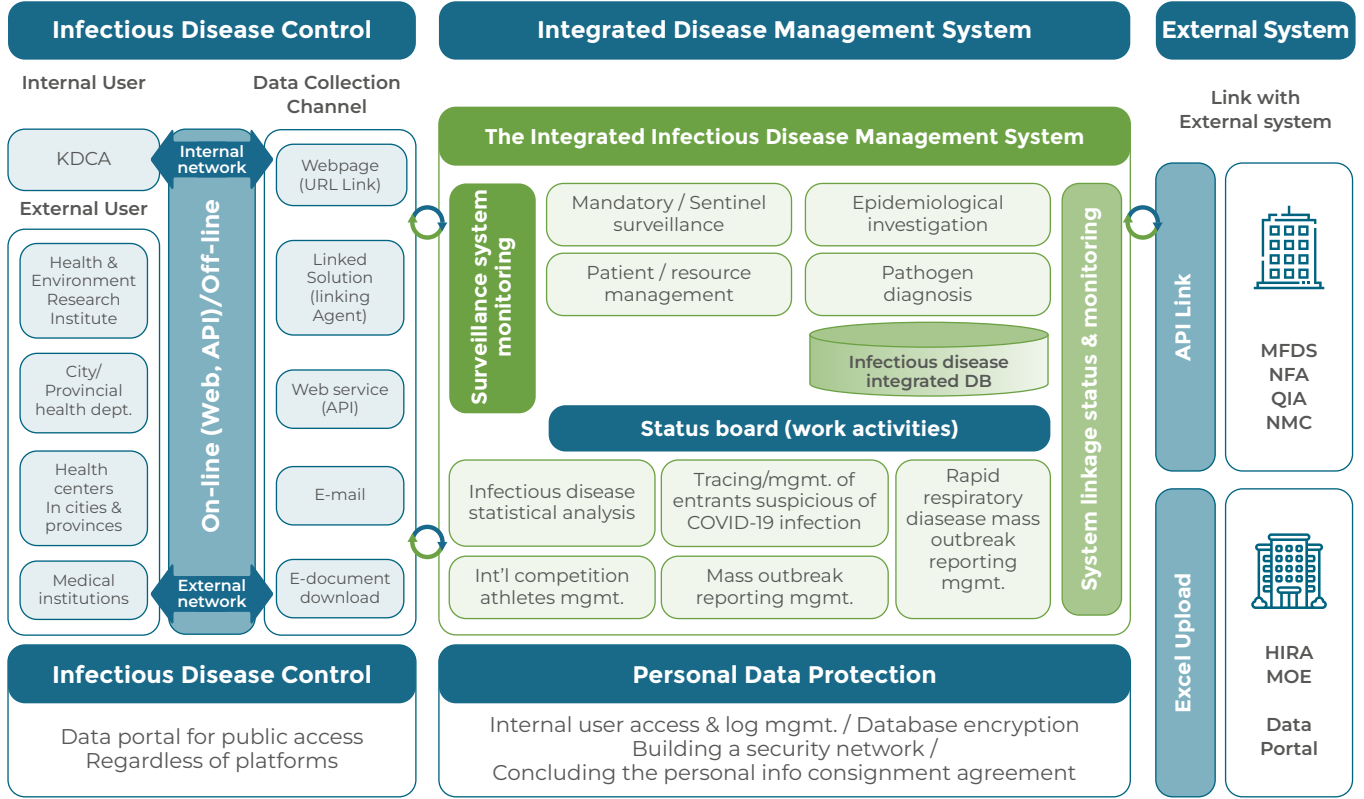
3.2.1. National Integrated Disease Management System (NIDMS)

The National Integrated Disease Management System (NIDMS) is an electronic management system built in the KDCA in 2015 for national disease control. The information system was operated according to disease and preventive function in the pre-NIDMS period but is now linked to all organizations related to disease control, quarantine/prevention, and sanitation, enabling integrated management. When an infectious disease control situation arises, information is collected in real-time. The AI-analyzed results are checked on the dashboard so the disease control authorities can make decisions during the golden hour.

The NIDMS is equipped with all functions necessary for infectious disease management (pathogen and vector monitoring, pathogen diagnostics, epidemiological investigation, vaccination, patient/contact management, tracking, preventive measures, etc.) An infectious disease is automatically recognized without a report by inputting the code from a hospital. With this well-prepared ICT infrastructure, the government can respond quickly and accurately to COVID-19.

The Korean government has disclosed related information via cloud-based open-API from the outset of the COVID-19 outbreak within the scope of not infringing on individual interest, enabling the private sector to rapidly develop apps related to the mask purchase and stock status, track confirmed cases and areas affected by COVID-19. However, despite some opinions that Korea's ICT-based response may infringe on human rights, all administrative measures are implemented within public health information governance.

FIGURE 9: National Integrated Disease Management System



Source: KDCA.

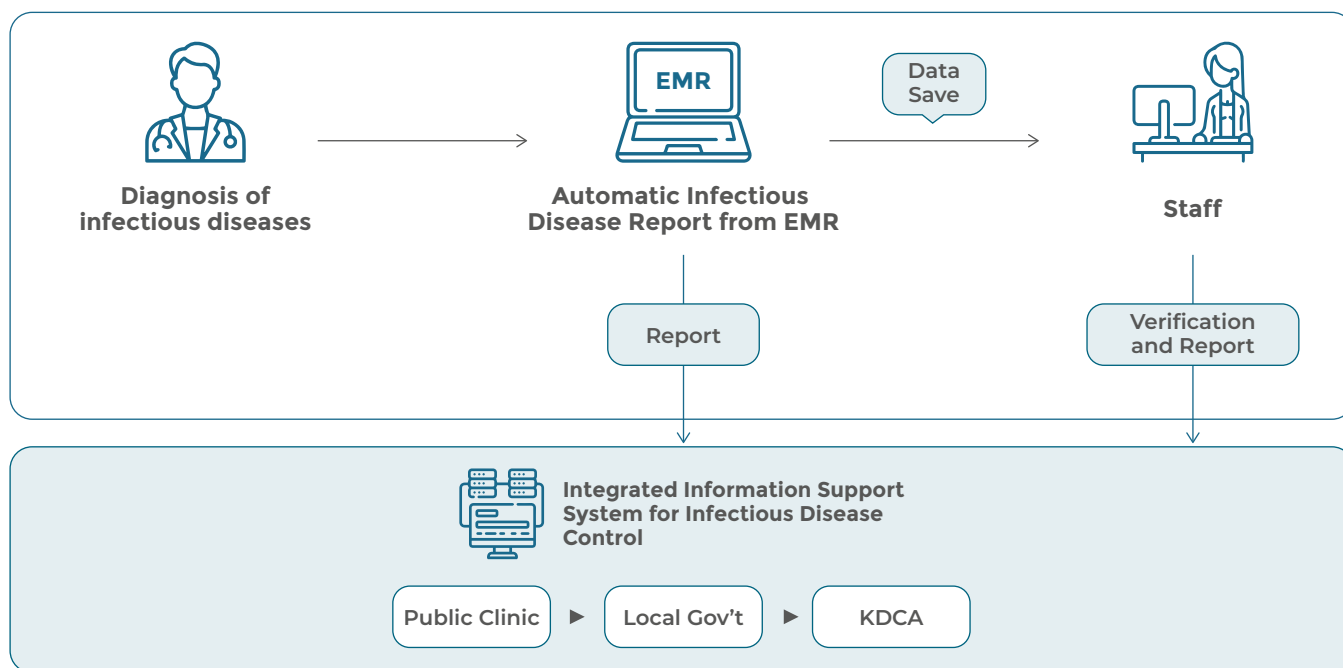


3.2.2. Automatic Infectious Disease Reporting System

The Automatic Infectious Disease Reporting System (Figure 10) provides real-time reporting of infectious disease outbreaks such as COVID-19 by linking the medical information system of medical institutions and the infectious disease monitoring system of the KDCA. According to Korean law, since 1954, the head of a medical institution must report an infectious disease without delay.

The system works as follows: when information on patients with infectious diseases is entered, a report on infectious diseases is transmitted through linked systems. When an infectious disease-related diagnosis code is entered in electronic medical records, basic data is extracted from the medical information system of each medical institution and an infectious disease outbreak report is prepared and sent to the infectious disease monitoring system (the public health center) of the KDCA.

FIGURE 10:
Automatic Infectious Disease Reporting System Process



Source: KDCA.

Note: EMR = electronic medical record.



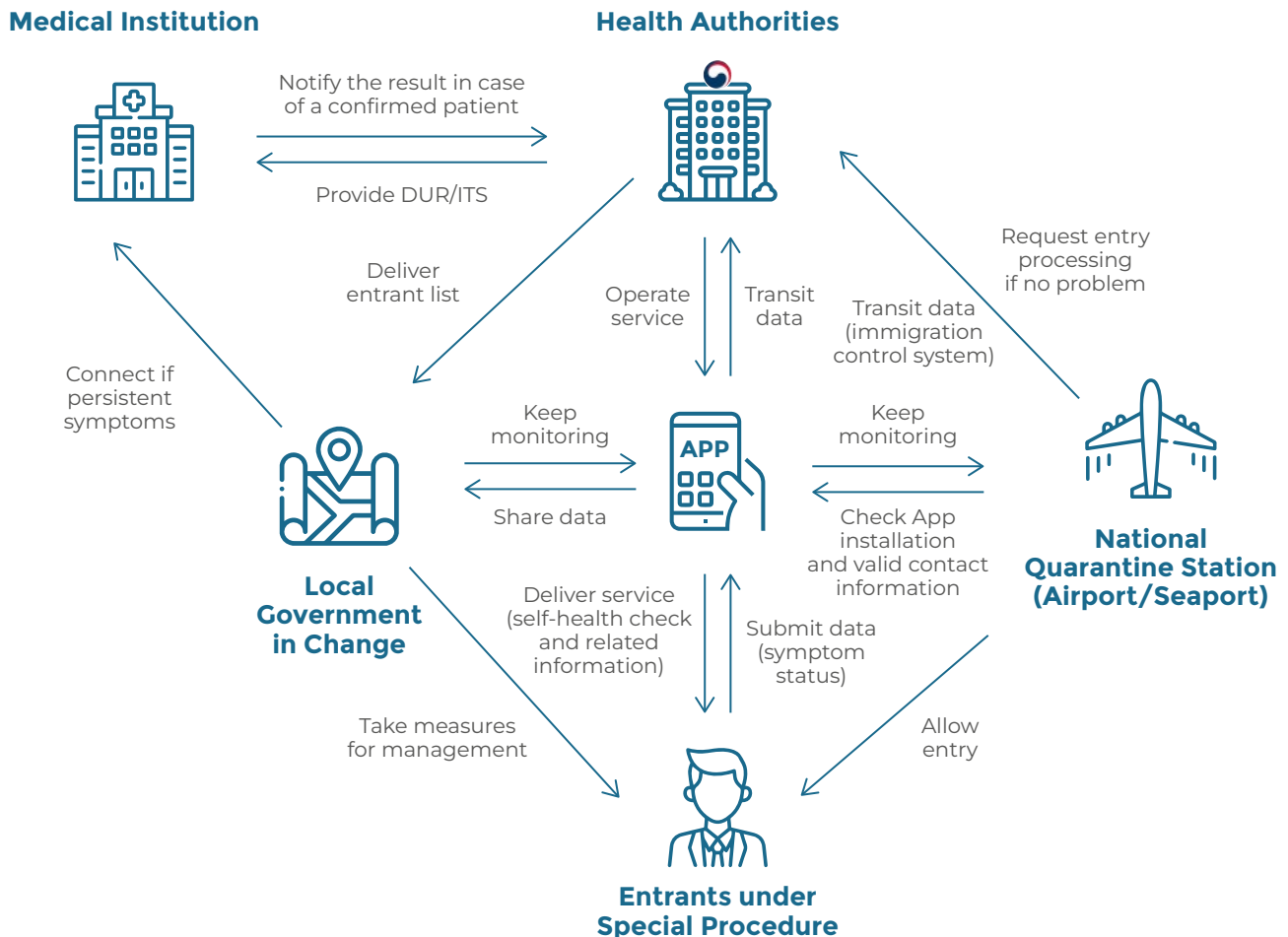
3.2.3. Self-Health Check App

The first thing travelers who enter Korea must do is fill out a Quarantine Declaration Form, install the Self-Health Check App on their mobile phones, and enter their traveler information. The International Traveler Information System collects the information entered through mobile authentication and delivers it to the relevant local government health authorities (Figure 11). Travelers must enter their health status every day for 14 days according to the app's instructions, and the local government monitors the input data in real time and manages users according to symptoms.

This measure aims to prevent the spread of infection during the incubation period of COVID-19.

The system sends an alarm to app users every morning at 10 a.m. to remind them to enter their health status information and sends a second alarm to those who have not yet provided information between 2 and 4 p.m. The local government contacts the users who have not submitted the symptom status three times or more, and the Korean National Police Agency tracks their whereabouts and visits them in person. In addition, the app enables users to find the nearest COVID-19 testing site from their current location as well as the status and contact details of the site. Furthermore, app users can answer COVID-19 symptoms and diagnosis questions through the KCDC 1339 call center and the KakaoTalk messaging app.

FIGURE 11:
Self-Health Check App Flow Chart



Source: NIA (2020).



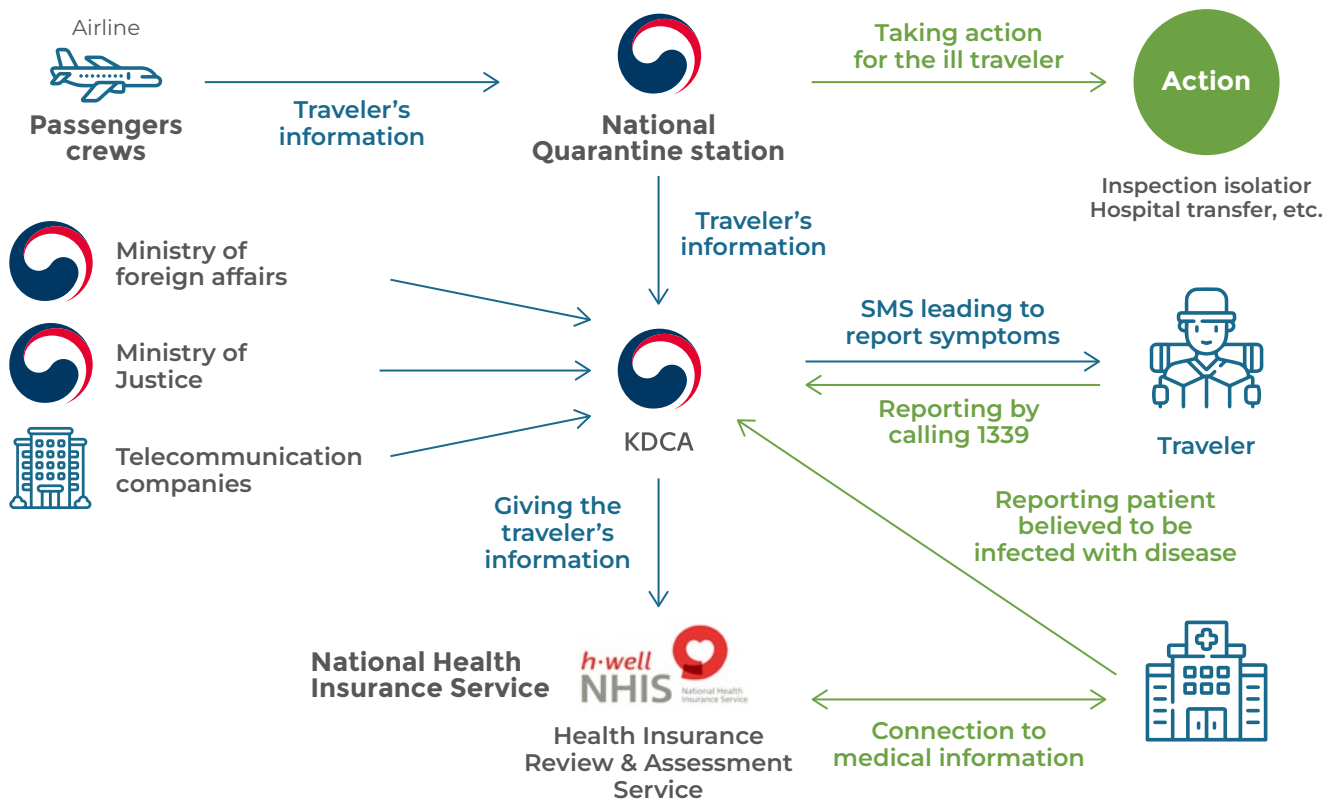
3.2.4. Smart Quarantine Information System

The smart quarantine information system (Figure 12) is an ICT network system designed to enable quarantine and route tracking of citizens returning from abroad and foreigners visiting Korea. The system is linked to a KDCA database that includes the Passport Information Comprehensive Administration System of the Ministry of Foreign Affairs, the Immigration Information System of the Ministry of Justice, the National Health Insurance Eligibility Inquiry System (NEIS) of the National Health Insurance Service (NHIS), the Drug Utilization Review² of the Health Insurance

Review and Assessment Service, and major telecommunication companies.

The KDCA combines traveler information and mobile phone roaming communication information to quarantine travelers entering from or through high-risk countries. The KDCA is automatically notified in real time of anyone who is confirmed as COVID-19-positive during the border screening or after entry into Korea, and potential risk groups such as contacts are also subject to surveillance. For example, if someone in a risk group visits a medical institution, the entire visit—starting from the reception desk—is geared toward preventing infection in accordance with the infection-risk-group information provided by the NHIS and the Health Insurance Review and Assessment Service.

FIGURE 12:
ICT Framework of the Smart Quarantine System



Source: NIA (2020), Reprinted with English translation by the NHIS.

² All medical institutions and pharmacies are connected via the ICT network, and doctors and pharmacists inspect and prevent inappropriate drug use by providing real-time drug information, such as information sharing about drugs and prevention of duplicate administration in the prescribing and dispensing processes.



3.2.5. Self-Quarantine Safety Protection App

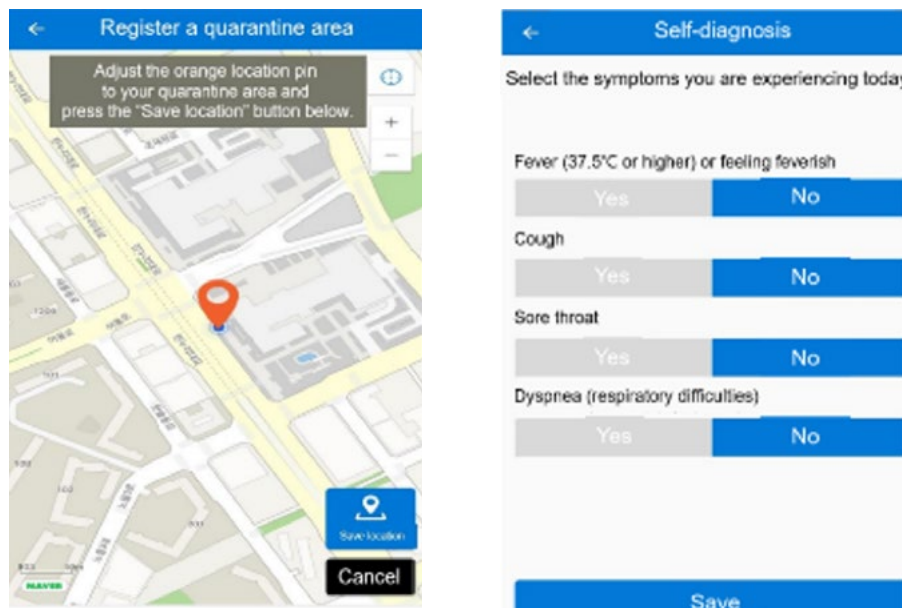
This app was developed by the MOIS to monitor all confirmed and suspected cases in quarantine.

Everyone arriving in Korea from abroad is required to download this app during their preventive quarantine before entering the country. App users find health recommendations and a symptom checker, which directly communicates with the KDCA if symptoms are serious and hospitalization is required. A GPS tracking system also ensures that people do not violate their quarantine restrictions (Figure 13). Each patient is assigned a health officer to monitor symptoms and enforce quarantine compliance, and violators are fined. In addition, in case of violations, a special bracelet is attached to the violator and connected via Bluetooth to a person's phone to prevent quarantine violations by leaving the phone at home. Repeat perpetrators

receive increased fines. First violations were initially set at ₩500,000 (\$430) but readjusted to ₩3 million (\$2,580). Repeat violations could face up to three years in prison or fines of ₩20 million (\$17,200) (Task Force for Tackling COVID-19, 2020). Shortly after the app was implemented, security concerns were raised: some data security issues were found that left detailed information of the users vulnerable, but the problem was quickly resolved (Park, Choi, and Ko, 2020).

An additional system for monitoring people's symptoms was introduced through free-of-charge AI-based call centers like HANCOM AI Check 25. These AI phone operators can make multiple calls at once, making it easier to provide personalized care to each person without needing as many operators. These services are created by private ICT companies, but relevant data for the management of the pandemic is shared with the KDCA if COVID-19 symptoms are detected or hospitalization is required.

FIGURE 13:
Self-Quarantine Safety Protection App



Source: Ministry of interior and safety.



3.2.6. EISS

The EISS is a contact tracing system that was initially developed as a Smart City Data Hub. The original project, developed by the Ministry of Science and ICT and the Ministry of Land, Infrastructure, and Transport, aimed to **collect urban data and solve a variety of problems related to transportation, the environment, energy, welfare, and safety, among others.**³ Since March 2020, the system has been used to trace all confirmed cases and identify close contacts to subject them to preventive isolation. To do this, the EISS visualizes the travel routes and spatial information of COVID-19-confirmed patients and their contacts on the platform's built-in digital maps.

A person confirmed to be infected with COVID-19 in a diagnostic test is traced electronically in terms of travel routes and payment information (credit card utilization data), subject to consent for the use of personal information, with the cooperation of the Korean National Police Agency, the three major telecommunication companies, and the Credit Finance Association of Korea. This tracing results in the automatic identification of their hourly whereabouts, the infection route, and finally, the location of the outbreak (hot spot).

Before this system was used, the tracing process could take up to three days, as it required an official document sent by the KDCA to the police department (or the Credit Finance Association) requesting information on mobile phone data (or credit card transactions). Then, the police department (or the Credit Finance Association) would send an official document to the mobile service providers (or credit card companies) requesting the data. The data would then travel back in the same route, also in official documents. This process is now completely digital and automatic, as shown in [Figure 14](#), and has reduced the time needed to 10 minutes. A message is sent directly to people's phones to alert them of contact with a

confirmed case so they can enter preventive isolation until they obtain a negative test (Park, Choi, and Ko, 2020).

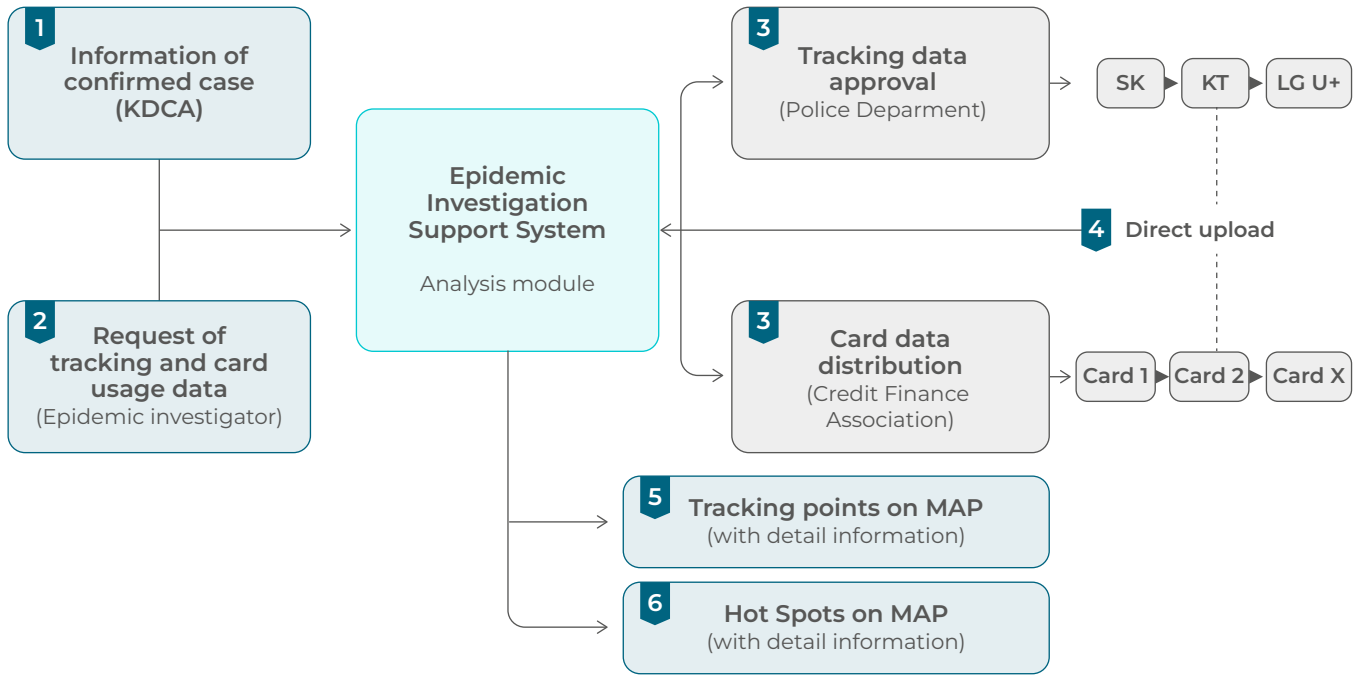
The EISS automates the tracking of confirmed cases and contacts. The KDCA's epidemiological investigation consisted of direct interviews with confirmed patients and collecting additional information from other related persons and groups. This time-consuming method had communication and accuracy problems owing to the recording process and difficulty investigating large-scale outbreaks. Therefore, an automated system was introduced to enable rapid and accurate investigations and analysis of many patients and contacts.

While it is certain that ICT tools have provided important support in the response, it is extremely challenging to accurately estimate the specific impact, as the COVID-19 pandemic is a multifactorial problem and there is no possible methodology to evaluate each factor individually. One indication of the impact of the EISS on contact tracing is that the time to obtain contact tracing information was reduced from three days to 10 minutes, which clearly affects prevention of secondary infections.



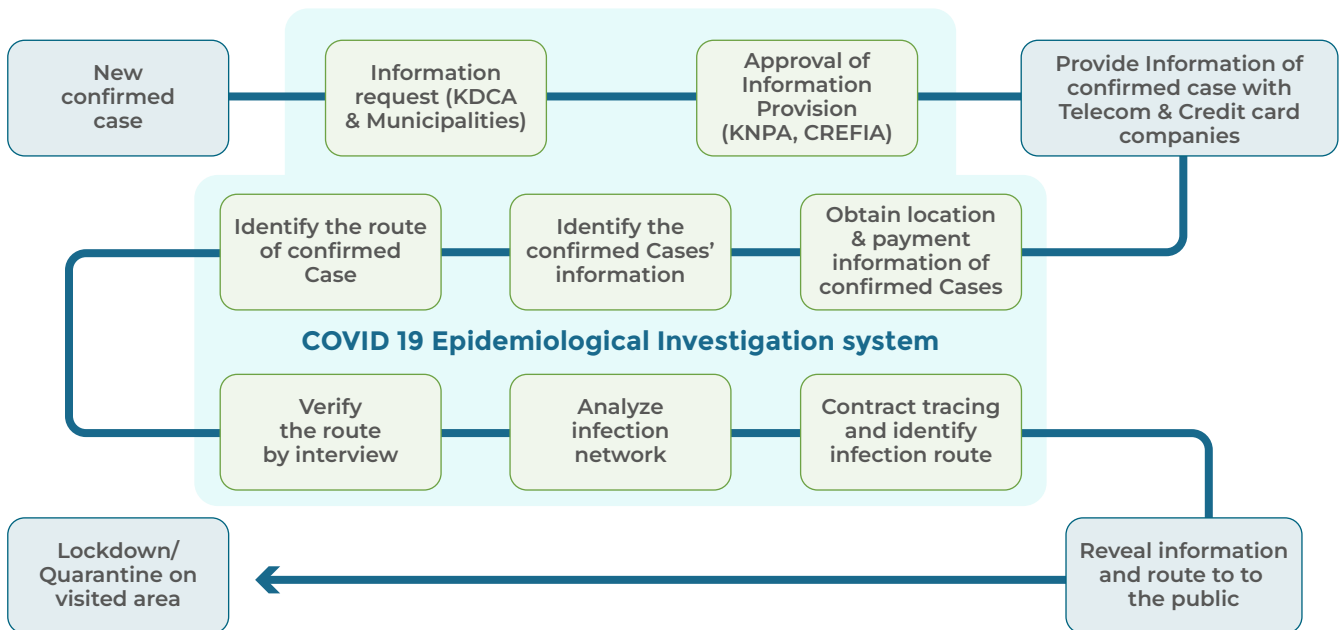
³ DEAP (Digital Empowered Agile Progressive) City Program is the joint R&D project of the Ministry of Land, Infrastructure and Transport (MOLIT) and the Ministry of Science and ICT launched for the purpose of developing cutting-edge smart city models by applying them to cities in Korea.

FIGURE 14:
Dataflow for the EISS Tracing System



Source: Brookings Doha Center (2021). (Adaptation from Ministry of Science and ICT).

FIGURE 15:
Epidemiological Investigation Flowchart



Source: NIA (2020).



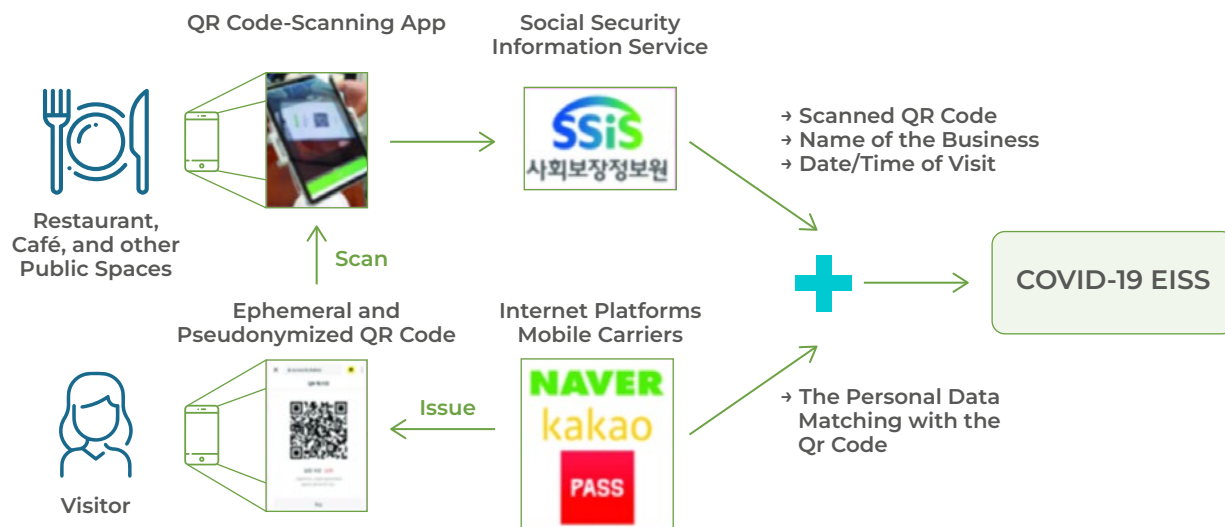
3.2.7. Korea Internet Pass

The Korea Internet Pass (KI-Pass), a QR-based system using an application developed by the MOHW to register people entering buildings, complements contact tracing (Figure 16). QR readers were placed at the entrance of highly visited buildings and facilities to easily track arrival and exiting times of people and quickly identify cluster infections before they grew too large. Upon entry, people would generate an anonymized QR code using the KI-Pass app that was scanned by the facility. In the case of an infection, information would be automatically sent to KDCA, which would alert other visitors, notifying of the possible transmission and instructing to enter preventive isolation until tested.

For the vaccination campaign, the KDCA created an official online registry system that people use to book an appointment for vaccination, although the reservation can also be made by phone. The available date reservations for each vaccination group were distributed based on the last digit of the birthdate (in format YYYY/MM/DD). The vaccination record of all citizens is kept within the KDCA database.

In mid-2021, the KDCA launched the COOV App, which served as a digital “COVID-19 vaccination passport” protected by blockchain technology for data safety. After downloading the app, users enter their personal data to verify vaccination status through the KDCA database. Then, the app generates a QR code that is scanned to confirm vaccination status (or recent PCR test results). App users can also scan someone else’s code and verify their vaccination status.

FIGURE 16:
Data Flow in the KI-Pass System



Source: Kwak (2020).

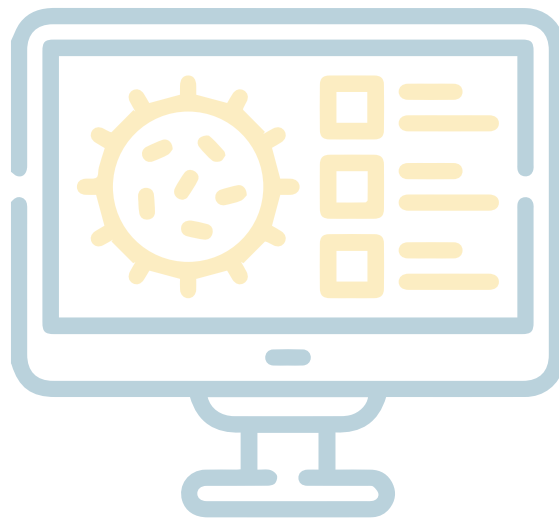
The public InfraBlockchain service is used, which is the first public blockchain developed without a native cryptocurrency, allowing the service to be provided for free and without restrictions.

This approach aims to resolve compatibility issues due to different digital vaccine certifications used around the globe (KDCA, n.d.). As Korea gradually reopens its economic activities, people are permitted to enter high-risk venues only with the vaccination passport of the COOV app, and those vaccinated have greater freedoms in general. For example, up to 10 people can gather in restaurants or cafes, but no more than four unvaccinated people are allowed to gather (COVID Pass Certificate, 2021).

According to KDCA protocols, vaccination doses that are not used within 6 hours after being opened must be discharged. In order to avoid wasting doses, Naver and KakaoTalk created online platforms so citizens without an appointment would receive the shots when the appointment holder misses the appointment, avoiding waste and delays in the vaccination rollout. The KDCA offers real-time information on vaccination and reservation absences in both platforms (Yonhap News Agency, 2021).

Additionally, Naver Clova developed Clova Care-Call to check on seniors (≥75 years old) for the three days following vaccination through phone calls.

These calls consist of an automatic voice assistant enquiring about general status and post-vaccination symptoms that could be associated with side effects. People who report that they feel unwell are connected to a human assistant who can determine whether the intervention of a doctor is required (Voicebot, 2021). **A similar tool was created by SKT's AI NUGU platform: an AI system named Vaccine Care Call that calls people to monitor side effects.** Health officials register the information of the people who present side effects in the system, and the system monitors these symptoms through phone calls. The AI system can categorize the symptoms to determine if further human intervention is required. This has proven to reduce the burden of health officials by handling 85 percent of the total reports and reducing more than 100 calls a day that were picked up by human operators (Seoul Metropolitan Government, 2021).



3.3. Health Service Provision Tools

Digital tools that support the provision of health services facilitate the work of health care personnel as well as protect them and other patients vulnerable to nosocomial infections. Section 3.3.1 discusses a tool that prepares health care personnel for future pandemics, and sections 3.3.2–3.3.5 discuss tools that make the work of health care personnel safer during the COVID-19 pandemic.

3.3.1. Computer Simulations

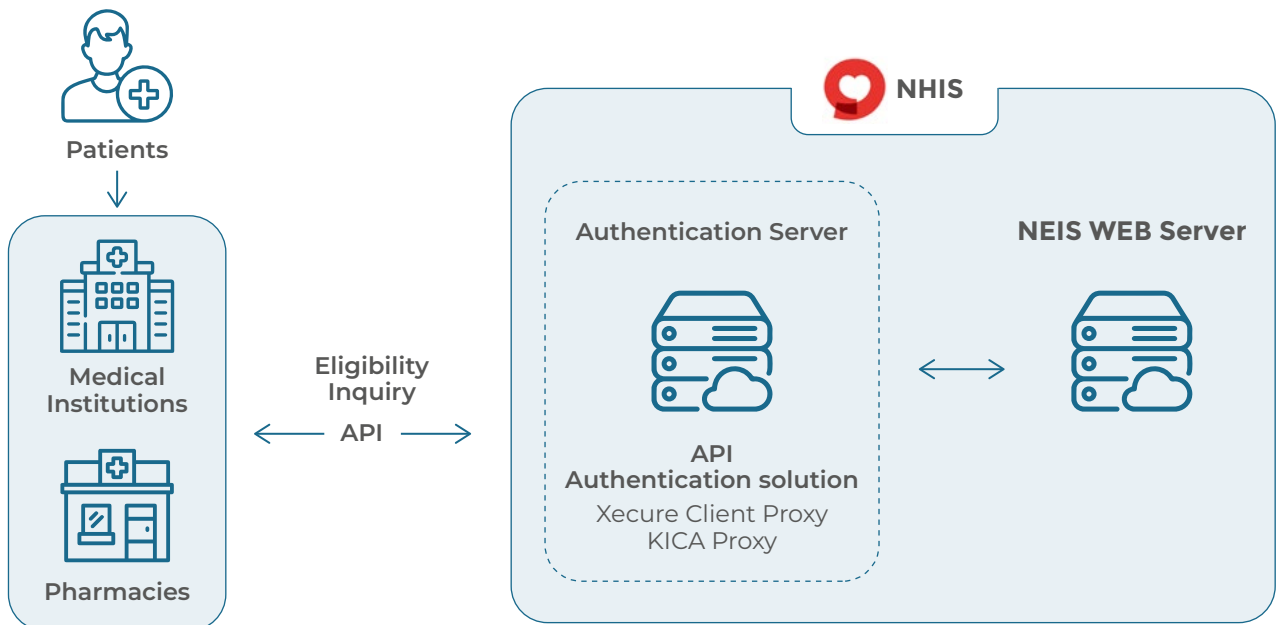
Korea conducts regular computer simulation exercises to prepare its administrative and health care staff in the event an infectious disease outbreak. Coincidentally, an exercise was conducted in December 2019 that simulated an outbreak of a highly contagious coronavirus imported from China. This provided a strong and very specific

preparation to tackle the real problem only a few weeks later. Such exercises identify and improve upon weaknesses in emergency response and train administrative and medical personnel for an adequate response (Brookings Doha Center, 2021).

3.3.2. NEIS

The NEIS allows a medical institution to inquire/confirm the eligibility of a patient's health insurance in real-time and register a first-visit patient (Figure 17). It consists of 53 items essential for operating the health insurance system, such as ID, gender, age, business location, residence, and travel information of all nationals, foreign workers in Korea, and foreigners staying for six months or longer. In the COVID-19 pandemic, the NHIS provides hospitals with NEIS information on persons at risk of infection such as contact information and travel information from high-risk countries to protect patients and health care workers from infection and prevent infection spread.

FIGURE 17:
The NEIS



Source: NHIS (2022).



3.3.3. Hospital Bed Availability

Hospitals and health centers are in constant communication with the KDCA through a website (https://www.hurb.or.kr/hira_sg/index.jsp) managed by the MOHW and the Health Insurance Review and Assessment Service, which reports information like available ICU beds and number of cases. ICU bed availability is reported according to three levels that indicate the patient condition: critical (vital signs are unstable and not within normal limits, patient may be unconscious), severe (vital signs may be unstable and not within normal limits, patient is acutely ill) and fair (vital signs are stable and within normal limits, patient is conscious). Because negative pressure rooms are essential for COVID-19 treatment, a proprietary system (Negative Pressure Isolation Room Information System) was created and integrated with the website that manages the status (number and availability) of negative pressure rooms, the status and severity of COVID-19 patients administered to the hospital, the status of health care workers and medical equipment, and the status of the people in charge of reporting (Kim, n.d.).



3.3.4. Telemedicine

The Medical Service Act forbids telemedicine, and the Korean Medical Association has rejected its implementation, arguing that it can lead to misdiagnoses and hinder the operation of smaller clinics that rely on geographical proximity (Jones, 2020; Kwak, 2020). Nevertheless, a special exception has been made during the COVID-19 pandemic to allow telemedicine consultations to reduce the risk of transmission. The consultations are conducted by phone or videocall, as text-based consultations are still not allowed. Doctors that prescribe medication communicate directly with pharmacies via fax or e-mail. Telemedicine consultations began in February 2020 in response to the Daegu crisis, and, between then and August 2020, over 700,000 virtual consultations in more than 7,500 medical institutions were conducted.

This emergency allowance of telemedicine led to the creation of Korea's first telemedicine app: Medihere. Medihere has provided its remote treatment platform to medical institutions free of charge for the duration of the pandemic (Hyun-tai, 2020). Dr. Now, another telemedicine app created for the COVID-19 response, is collaborating with over 150 hospitals and has about 110,000 active users per month as of August 2021 (Soo-min and Kim, 2021). As of November 2023, the MOHW is currently implementing a telemedicine pilot to pave the way for the legalization of telemedicine in the country.



3.3.5. Digitalized Health Care

Korean hospitals are also equipped with ICT tools to reduce workloads and protect workers. One such example is the Lunit INSIGHT CXR AI system that can read and interpret X-ray and CT-scan images within seconds. Such technologies, when combined with digitalized medical records and symptom monitoring, can help health care personnel to monitor patients' symptoms faster and without coming into direct contact with them. The Seoul National University Bundang Hospital (SNUBH), for example, became the first paperless hospital in Pacific Asia in 2003. Since its creation, SNUBH has been using their own electronic health record (EHR) system, BESTCare, which integrates all the patients' data into a single platform.

Within BESTcare, a dashboard called "BEST-Board" was implemented in 2012 that allows doctors to monitor many patients at a time. In 2013, this hospital digitalization was complemented with the Health4U app for personal health records. In this platform, people can enter relevant health information such as daily exercise, weight, blood pressure, blood sugar, and lab results among other relevant health indicators (Jung *et al.*, 2017). When connected to the hospital's network, Health4U can also monitor patients' vital signs in real time and communicate automatically with the BESTCare system, allowing doctors to remotely monitor their conditions. As a failsafe, these data can also be introduced manually by the patient.

Patients can also manually introduce any complaints, which are communicated through to the BESTCare platform (Figure 18).

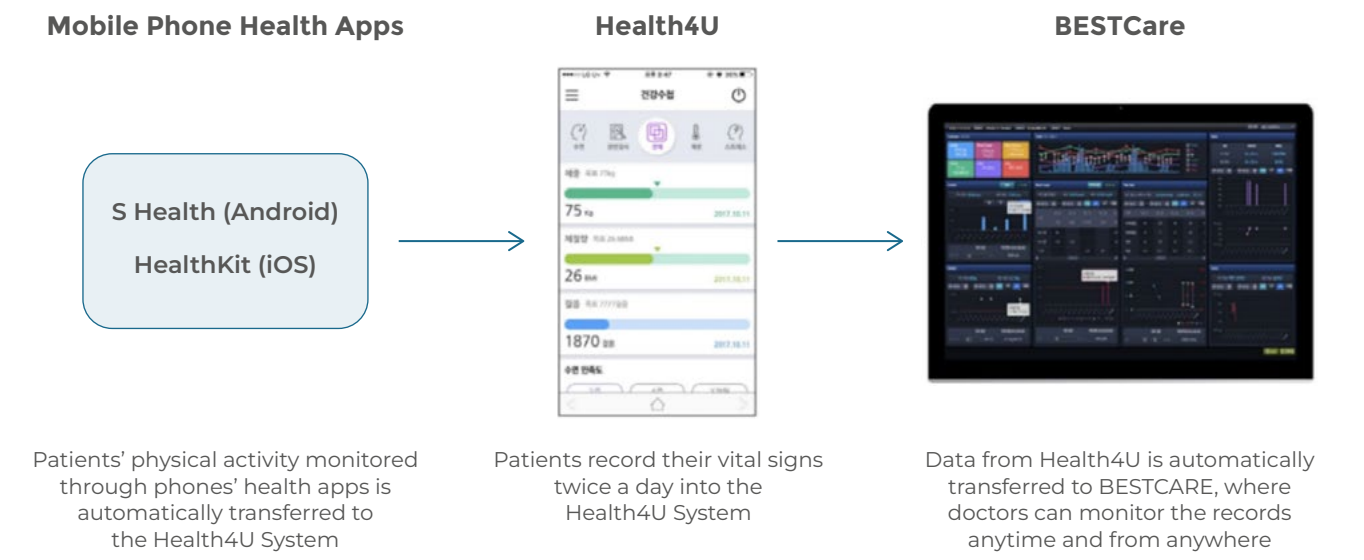
Although these systems were originally created for the monitoring of noncommunicable chronic diseases, they have provided important support in the fight against COVID-19 (Shim, 2020). Many hospitals and clinics have adopted the SNUBH's BESTCare system, while others have created their own similar systems, and EHR adoption has reached over 93 percent in hospitals and 91 percent in clinics.

The advanced ICT infrastructure of the SNUBH detailed above has been vital during the COVID-19 emergency for monitoring patients in some hospitals and RTCs, and it facilitated the quick creation of a “digital field hospital” to manage the treatment of infected cases more easily. The design of these RTCs was done to minimize the required number of health care personnel on-site and their direct contact with patients. To do this, all patient records and the live monitoring of their vital signs is digitalized and uploaded into

the BESTCare platform, which allows telemonitoring of all patients so that direct interventions are made only when necessary (this system was implemented in the RTCs operated by the SNUBH). For example, patients have daily videocalls with doctors to check on symptoms, which replaces the in-person rounds normally conducted in hospitals.

The AI-based diagnostic systems for interpreting results from X-ray and CT-scan images, such as the Lunit INSIGHT CXR, have also been installed in several Korean hospitals in Daegu, Seoul, and nearby areas to ease the burden on the medical workforce and make a more efficient system for diagnosis and symptom monitoring, as making these diagnoses in person takes longer and may be prone to errors (Ministry of Science and ICT, 2020). These algorithms have reportedly reached a detection sensitivity of 98 percent for CT scans and 69 percent for X-rays, making them a great alternative for in-person diagnosis in hospitals (Mohammad-Rahimi, H. et al. 2021). However, there are still some limitations. For example, there is still no uniform standard for detection accuracy,

FIGURE 18:
Health4U Communications Using the BESTCare Telemonitoring System



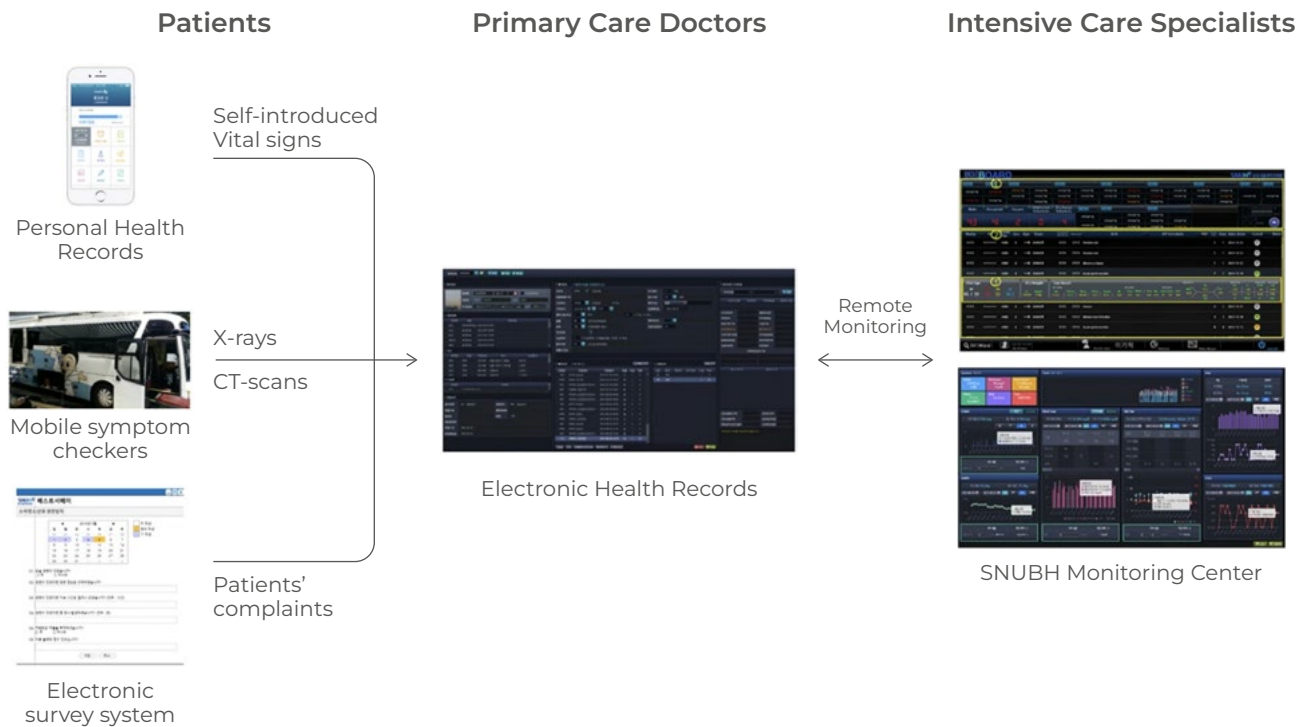
Source: Yonhap News Agency (2021). (Adaptation from the Ministry of Science and ICT).

and there is no public training available for a large number of datasets. Reports also claim that these AI diagnostic systems have been of no consequence during the pandemic, mainly because of the poor data sets used in the development of these tools (Haved, 2021).

As of 2021, Korea had adopted these systems even though more research was needed and the methods needed be improved before AI algorithms became more popular for diagnosing COVID-19 (Zhang, 2021). However, **the ability of these systems to conduct diagnoses remotely, thus minimizing even further the possibility of health care personnel becoming infected, is an advantage.** As shown in [Figure 19](#), these systems can report the results directly to the BESTCare platform so doctors can telemonitor the patient (Choi, 2021; Koh, 2020).

The transition to digital health care systems is a natural progression that facilitates many administrative and logistic processes and reduces burden of the health care personnel. In some technologically advanced countries, like Korea, this transition was already underway when it was accelerated by COVID-19. Other complementary systems like AI-based symptom checkers could also be helpful for interpreting test results quickly and remotely, though these may be less fundamental to the response, and they are still not completely established.

FIGURE 19:
Digital Patient Telemonitoring System



Source: Yonhap News Agency (2021). (Adaptation from the Ministry of Science and ICT).

3.4. Information and Data Security



3.4.1. Balancing Privacy and Public Health Concerns

Korea has conducted contact tracing to efficiently identify close contacts with confirmed cases and subject them to preventive quarantine until they are tested, and its legislation allows for special emergency measures such as the close monitoring and tracing of any infected citizen by the government through mobile phone signal, CCTV, and credit card transactions (Intralink, 2019; Kemp, 2021). But some argue that this usage can be considered a violation of people's privacy. Furthermore, this detailed tracing, although anonymous in principle, can lead people to personally identifying the infected individuals who, in some cases, have become subjects of public disdain. Establishments that had been visited by infected individuals also experienced a decrease in business. In response to this, Korea began limiting the detail of the officially released information in 2020 (Park, Choi, and Ko, 2020).

Some studies have attempted to quantify the worth of Korea's potentially controversial practices. One study analyzed data from the first outbreak in Daegu (February 2020) to show that the combination of non-lockdown social distancing regulations with detailed contact tracing can effectively reduce the basic reproduction number⁴ to below 1, even from as high as 5.6, but either measure alone does not lower it (Chen, Fang, and Huang, 2021). Another study confirmed that the combination of measures has a strong mitigating effect, although it concluded that with a high initial reproduction number, it may not be as effective (Ryu, Abulali, and Lee, 2021). That said, it is important to highlight the limitations of these studies, as several assumptions and simplifications had to be made to apply the quantitative models.

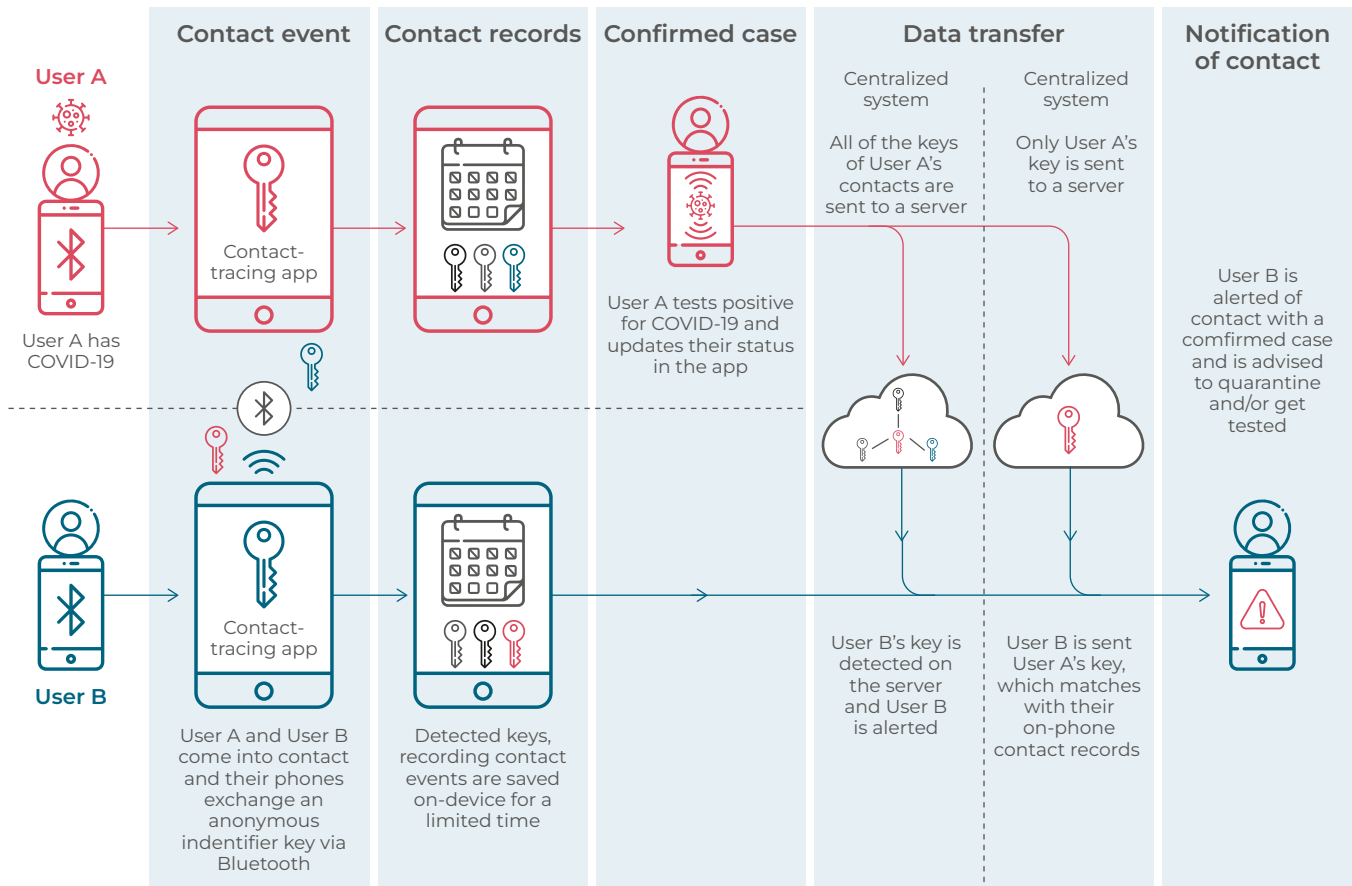
Less invasive alternatives to Korea's contact tracing model include a Bluetooth-based proximity detector app that has been used in many other countries, such as Australia (COVIDSafe), Denmark (Smittestop), and Singapore (Trace together), and there is the Gapple app released by Google and Apple (Shahroz *et al.*, 2021). In these apps, the information on close contacts is encrypted and anonymously kept and for a few days in case someone is identified as a confirmed case, in which case a notification is sent to all close contacts to get tested and enter preventive quarantine, as described in [Figure 20](#). The impact of such solutions, however, would depend on the percentage of the population using the app (Budd *et al.*, 2020). An advantage of these methods, relative to the Korean tracing system, is data privacy: people's locations are not being tracked, and only proximity with other phones is recorded. Furthermore, contacts' information is protected through blockchain technology rather than being centralized, as it is in Korea's EISS.

In addition, the Self-Quarantine Safety Protection App could also be perceived as highly invasive of people's privacy because of the detailed location monitoring. **According to the Korean experts interviewed for this paper, there are two main requirements for implementing similar systems in other countries:**

1. Sufficient smartphone penetration, which is vital for using the apps and triangulating the user's location.
2. Legislation permitting such tracking of citizens during emergencies.

⁴ The basic reproduction number (R_0) is an epidemiologic metric used to describe the contagiousness or transmissibility of infectious agents. It is defined as the expected number of cases directly generated by one case in a population where everyone is susceptible to infection.

FIGURE 20:
Bluetooth-Based Contact Tracing System



Source: Budd et al. (2020).



3.4.2. Ensuring Cybersecurity

Korea has implemented a pan-governmental cybersecurity national plan that delineates the development of a protection system encompassing the public, private, national defense, finance, and health sectors. With one of the most prosperous cyberspace environments with advanced ICT technology, Korea has a need for regular monitoring of cyberspace security and frameworks. The National Cyber Security Center under the National Intelligence Service (NIS), established in 2004, is responsible for public sector cybersecurity activities. The National Cyber Security Center, under the relevant laws, conducts security assessments



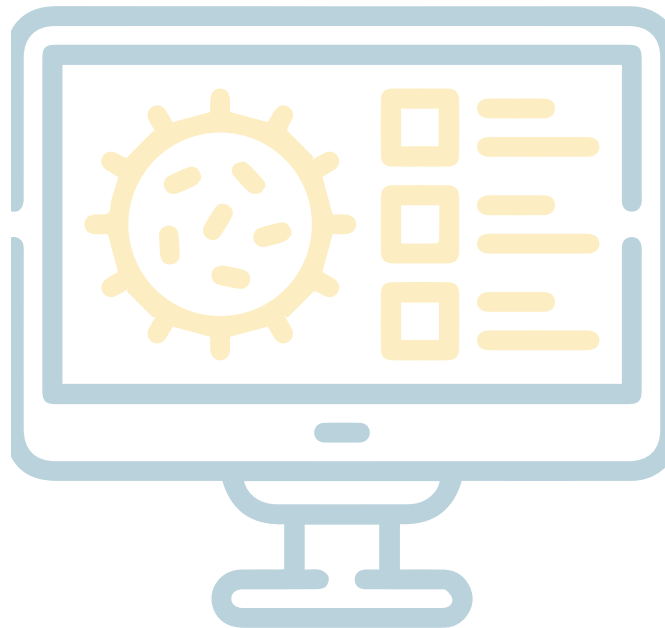
on national and public information communication networks to identify security vulnerabilities and provide consultation for institutions to establish security measures. Also, more than once a year, central administrative officers are obliged to carry out security assessments and inspections to prevent attacks and threats in cyberspace.

Furthermore, the Integrated Infectious Disease Management Information System contains a digital signature authentication system called Government Public Key that guarantees the identification of administrative agencies and public officials and prevent forgeries and falsification of electronic documents. Those who access the portal need to register and use their digital signature.



3.4.3. Maintaining Information Integrity

In an effort to battle against fake news, the Korean National Police Agency created the Cyber Bureau to monitor online information related to the pandemic and dispatch investigators to the CD-MHQ, which monitors for fake news. In addition, the agency set up an emergency communication channel with the KDCA and the Korea Communications Standards Commission, which oversees all communications using information and communications technology (ICT). When the Korean National Police Agency detects any fake news on COVID-19 that could cause serious social disorder, it requests that the commission remove or block the illegal information.





“The best time for making critical decisions is in periods between pandemics, as mistakes and improvements can be discussed in a calm environment.”

Dr. J. Kim,
Director General of the International
Vaccine Institute





4.

RECOMMENDATIONS



4. RECOMMENDATIONS

↪ **Korea's groundbreaking use of ICT tools has been vital to the communication, prevention, surveillance, and treatment efforts during the pandemic.** But it is also important to note that Korea's success has not depended on only the digital tools used (Chekar, Moon, and Hopkins, 2021), since a number of other factors play a role, such as personalized attention to quarantined people, the pan-governmental response, the innovation and flexibility to provide solutions to arising problems (like opening the RTCs), and requesting civic engagement, which promotes cooperation and compliance. The technological tools therefore support, complement, and enhance Korea's response strategies.

↪ **Korea has been able to mitigate most of the disastrous effects of COVID-19 through strong leadership, civil compliance, and advanced ICT systems that support several areas of the emergency response.** In any emergency such as the COVID-19 crisis, countries must make use of all available resources to mitigate the impact of the crisis, including ever-evolving technological developments to support and enhance the response. While Korea's economic stability and advanced technological infrastructure have provided the country an important advantage, a few recommendations for developing digital tools can be extracted from Korea's response that are useful for strengthening emergency preparedness and response systems globally. The recommendations are grouped according to when they are implemented, either in preparation for or in response to an outbreak.



4.1. Preparing for Emergencies

Increase investments in infectious disease research and development

Large investments in infectious disease research and development allowed Korea to develop and mass produce diagnostic testing kits just three weeks after the first case was reported in the country. The Korean budget for addressing new infectious diseases has increased more than 180 percent in five years, from ₩68.8 billion (\$57.3 million) in 2015, to ₩194.3 billion (\$161.7 million) in 2020. As a result, epidemiologists and infectious disease experts have been thoroughly trained and were ready to provide expertise in the response efforts.

Invest in technological development and the health care system

Korea has implemented advanced digital solutions to support its response strategies, but the advanced technological environment allowed for the tools to be developed within the country. Since not all countries are at the same level of digital readiness, some countries may benefit from adopting digital tools developed elsewhere. Many solutions require minimal digitalization of government systems and internet access, particularly for communication needs (for internal government use and for keeping the public informed), case management, and civic engagement. Improving a country's digital readiness may require a significant investment, but it will facilitate the implementation of digital solutions in case of a new outbreak, such as easing transitions to working from home and distance learning. The digitalization of medical services, such as telemedicine and remote patient monitoring, entails many advantages such as greatly expanding the reach of health care in a country and has also proven useful in the fight against COVID-19 by minimizing the risk of infection in health centers and protecting medical personnel. It is crucial for countries to assess their digitalization status to

determine which digital solutions can be successfully implemented.

4.2. Responding to Emergencies

Define and monitor KPIs

KPIs (such as the daily number of new cases, the effective reproduction number, the number of ICU beds available, and even public wellbeing) must be defined early on in an outbreak to assess the impact of the disease and the impact of implemented responses. The emergency response system should also have the flexibility to quickly adapt to the developments reflected in the data and implement changes in the strategy as necessary. A dedicated team must be assigned to assess the data, and efficient communication lines must be established within the government to ensure the decision-making process is based on the latest information.

Promote compliance and civic engagement in the emergency response

Civic engagement has been a pillar of the Korean response. **The Korean Safety e-Reporting system has been developed for citizens to report health violations and voice concerns or complaints with the government.** Implementing such online systems to obtain feedback from the population can help the emergency response by promoting the public's active involvement. But it is also important to consider the level of trust in the government, as low levels of trust can generate lower compliance levels. Open communication and total transparency from the government as well as direct population involvement in the response increase trust in government and, thus, compliance with regulations.

Similarly, involving the private sector in the response can be effective, such as when companies

in Korea created online platforms and mobile apps to help in the response efforts. Additionally, ICT companies provided software and technical support for other businesses to transition to the home-office regime. While there are considerable advantages in involving the private sector in the communication ecosystem to better inform the population on the situation, it also raises the issue of misinformation. A consensus of the information to be shared and the official sources to be used must be reached to prevent sharing of conflicting information.

Use contact tracing for reducing secondary infections

Contact tracing has proven vital in the early identification of potential infections, which can considerably reduce the spread of the disease if close contacts are preemptively quarantined. Korea's EISS requires advanced digital means (tracking of citizens' phone signals) as well as legislation that permits this detailed tracking. This last point has been a subject of debate, so a balance needs to be sought that maximizes the reach of the contact tracing while respecting people's privacy. Some Bluetooth apps do not require detailed tracking, so they might be a better solution.

Another strategy is to conduct less technologically intensive contact tracing, for instance through phone interviews. This approach relies on the honesty and cooperation of the people interviewed and requires a digital database of confirmed and suspected cases to facilitate the management of the pandemic, identify and prevent new infections, and predict increases in the demand of health care services.

Create a tailored notification system to alert and inform citizens

The Korean CBS has been used to send personalized information and alerts to citizens during the pandemic. These messages are highly personalized. For instance, messages may notify recipients of a newly confirmed case within their apartment/condo building, and advice to take extra precautions, or the messages can simply let a person know that he/she has been in close contact with a confirmed or suspected case and needs to enter preventive isolation until tested.

Some privacy concerns have also arisen from this strategy: even though no personal information is provided, the level of detail has allowed some positive patients to be identified, which may lead to stigmatization (BBC, 2020). The ability to provide such detailed information is limited by the level of contact tracing as well as data protection legislation in the country, but general tailored messages can still be useful to alert specific segments of the population. Because the alerts are text messages, access to a cellphone but not necessarily a smartphone is needed, which expands the reach of this tool. These messages can be used to alert recipients of a sharp increase in the incidence rate of a specific city or region, for example, thereby advising citizens in that area to take extra precautions.





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