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Effect of the establishment of the Korea Centers for Disease Control and Prevention/Korea Disease Control and Prevention Agency from the perspective of global health security

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Abstract: The Korea Centers for Disease Control and Prevention (KCDC) was established in 2004 after the SARS epidemic. As a national disease control agency, KCDC strengthened its capacities for global health security based on experiences from some important issues such as the Influenza A/H1N1 pandemic (2009), the Middle East Respiratory Syndrome outbreak in Korea (2015), the Zika epidemic (2016), and COVID-19 pandemic (2020-2024). KCDC can make or revise infectious disease prevention and control related law, and collect, manage and analyze disease data from all the local public health centers and medical institutions in Korea. Based on the indicator-based surveillance, event-based surveillance and laboratory-based surveillance, KCDC conducts risk assessment for public health threats and has full responsibility as a competing authority in responding to outbreaks on a legal basis, which is specified in the national disaster framework. All quarantine stations in airports and sea ports belong to KCDC, and individual international travel history data at point of entries are linked to the National Health Insurance Services Database and medical doctors can access the database when the symptomatic individual visits the clinics/hospitals to check his/her travel history in the affected countries. This is a backbone to identify and notify imported infectious diseases from local clinic/hospitals to KCDC. Based on risk assessment in KCDC, KCDC triggers the Emergency Operations Center to respond. This KCDC-centered public health governance with centralized, comprehensive surveillance and response is one of the model cases from the health security perspective to consider for countries that are to establish new national public health institutes in the post-COVID-19 era.

***Keywords*:** emerging infectious diseases, national public health institute, health security

Introduction

The World Health Organization (WHO) revised the international Health Regulations (IHR) (2005) to strengthen the member states' core capacities for monitoring, laboratory diagnosis, prevention and response to infectious diseases in preparation for potential global and regional public health threats after the severe acute respiratory syndrome (SARS) epidemic (*1*). Each member state is required to submit a self-assessment report annually to the WHO on implementation of the IHR core capacity. In 2014, the Ebola epidemics in West Africa raised the limitations of IHR self-assessment, thus prompting establishment of a new mechanism to evaluate and further strengthen capacities for response to public health emergencies across all member states (*2*).

With the existing IHR monitoring and evaluation framework, WHO created the Joint External Evaluation (JEE) tools in 2016 with the Global Health Security Agenda. WHO recommended member states to participate in JEE on a voluntary basis to assess the extent of their core capacities and reflect evaluation outcomes accordingly in national plans (*3*).

The Republic of Korea (ROK) acknowledged the necessity for a unified public health agency with a systematic national disease control system against emerging infectious disease threats. The Korea Centers for Disease Control and Prevention (KCDC) was established in 2004, and it covered disease prevention and response, quarantine, and research (*4*). The Middle East respiratory syndrome (MERS) outbreak in 2015 stimulated the government of ROK to reform the National Infectious Disease Control System to be able to respond to emergencies. Reshaping efforts were made in the legal system, protocols/ guidelines, the quarantine system, information sharing and collaboration between different sectors, collaboration between central and regional governments, inter-ministerial and muti-sectoral collaboration, the national laboratory system, surveillance, health workforce, and risk communication.

This reform enhanced the national capacity to respond to public health emergencies during the early state of COVID-19 (*5*). To prevent and prepare for a future pandemic, the KCDC, an affiliated organization of the Ministry of Health and Welfare, upgraded to an independent government agency with the name of the Korea Disease Control and Prevention Agency (KDCA) in 2020. KDCA oversaw regulations such as the infectious disease control and prevention act and has practical authority over infectious disease policies and enforcement. Epidemiological investigations, disease control research and projects and health promotion are also carried out under the authority of the KDCA (*6*).

In this article, the author reviewed the background in establishing KCDC/KDCA after major emerging infectious disease outbreaks, and summarized the technical areas to strengthen the prevention, detection and response capacities in ROK with the aim of measuring the effect of establishing a national public health institute to detect and respond to COVID-19.

Literature search and effect measurement

Literature Search Strategy

The author searched for all the white papers of the KCDC/KDCA since its inception with special attention to the year when the major public health events such as Influenza A/H1N1, Zika, MERS outbreak, and COVID-19 (*7-12*). To find the effect of the reform, mainly focused on the restructuring of KCDC, the author checked the JEE mission report of the Republic of Korea published in 2017 (*5*) and IHR States Parties Self-Assessment Annual Reports (SPAR) on the WHO website during the COVID-19 pandemic (*13*).

Measuring the Effect of Establishing KCDC/KDCA

To measure the effect of establishment of a disease control agency in the context of global health security, the author followed the JEE evaluation tool and compared the scores in the selected comparable technical area of JEE and SPAR. ROK's JEE scores in 2017 and SPAR scores during the COVID-19 pandemic era (2021-2023) were used for comparison. Based on the JEE tool (first edition), the author chose the relevant technical areas in which KCDC was the main actor in the preparedness and response for infectious disease threats in ROK. 14 out of 19 technical areas were selected to measure the effect of KCDC/KDCA establishment (Table 1) (*14*) . The mean scores of all indicators in a technical area of JEE were taken and converted into a 100-point scale to compare with SPAR scores.

Strengthened capacities

National legislation, policy and financing

The ROK had a comprehensive and concrete legal basis to implement the IHR (2005). For human infectious diseases, the Ministry of Health and Welfare (MOHW) and the KCDC/KDCA operate under the Infectious Disease Control and Prevention Act and the Quarantine Act. For animal diseases, there was the Act on the Prevention of Contagious Animal Diseases. Ministries from other sectors conducted their activities according to the IHR (2005) all hazards approach under various laws such as the Nuclear Safety Act and Chemicals Control

Table 1. Summary of JEE Scores and SPAR scores of the Republic of Korea

Technical Area	JEE[a] 2017 (*5*)	SPAR (*36*)		
		2021	2022	2023
PREVENT				
National Legislation Policy and Financing	100	60	100	100
IHR Coordination, Communication and Advocacy	100	87	87	93
Antimicrobial Resistance[b]	95	100	100	100
Zoonotic Disease	80	100	100	100
Biosafety and Biosecurity	90	NA	NA	NA
Immunization	100	NA	NA	NA
DETECT				
National Laboratory System	95	100	100	100
Real time Surveillance	95	100	100	100
Workforce Development	93	90	100	100
RESPOND				
Emergency Response Operations[c]	90	100	100	100
Linking Public Health and Security Authorities	100	NA	NA	NA
Risk Communication	93	100	93	93
POINTS of ENTRY	100	100	100	100

Data source: WHO (*5,36*). [a]Although JEE and SPAR are based on a 5-point scale, the WHO SPAR website converted the scores into a 100-point scale with mean scores of each technical area; [b]In JEE, Infection Prevention and Control are included in AMR; [c]Emergency Response Operations are included in Health emergency management in SPAR (See Discussion). *Abbreviations:* JEE: Joint External Evaluation, SPAR: States Parties Self-Assessment Annual Report, IHR: International Health Regulations. NA: Not Available.

Act (*5*).

The ROK regularly reviewed and revised relevant laws to align with requirements under the IHR (2005) and after major public health events to incorporate lessons learned into the existing legal system. This includes a major revision or amendment of the relevant laws in 2005 after IHR (2005) were adopted, after the Middle East Respiratory Syndrome (MERS) outbreak in 2015 and COVID-19 in 2020 (*15-18*). In the 2020 amendment, KDCA had full responsibility in the outbreak response (*18*).

The ROK allocated regular annual budgets with reserve funds and supplementary budget for health and relevant ministries to prepare, detect, and respond to public health emergencies (*5*).

IHR coordination, communication and advocacy

The KCDC/KDCA was the national IHR focal point (IHR NFP) in ROK and had a well-established system with high-level expertise for IHR coordination, communication, and advocacy. Since the MERS outbreak in 2015, a dedicated division in the KCDC was established for systematic domestic and international information collection and risk assessments. Since 2016, the dedicated division in the Center for Public Health Emergency Preparedness and Response in KCDC served as IHR NFP and oversaw the ROK's progress for IHR (2005) implementation (*5,9*). During the initial stage of the COVID-19 pandemic in 2020, the division conducted risk assessment and based on their assessment appropriate countermeasures were conducted (*19*).

Antimicrobial resistance

For the first stage of the National Antimicrobial Resistance Safety Management Program (2003-2007), antibiotic consumption volume and antimicrobial resistance in human, animals, food and agricultural production were assessed to devise national action plans in both clinical and nonclinical settings, improve public awareness, promote education, and build international collaboration. A national surveillance system was implemented to monitor cases of healthcare-associated infections, and a new pharmaceutical law regulating the collection, disposal, and small packaging of drugs, as well as the transport and disposal of hazardous drugs were legislated (2006).

In the second stage (2008-2012), a legal framework for infection control was established. A dedicated surveillance system for healthcare associated infection was implemented, and specialized education programs for infection control were offered. The Korean Antimicrobial Resistance Monitoring System (KARMS) Annual Report was published, and the Culture Collection of Antimicrobial Resistant Microbes was opened, together providing the foundation for research and development in the field.

Based on WHO's Global Action Plan on Antimicrobial Resistance, ROK developed the National Antimicrobial Resistant Management Action Plan (2016-2020) in 2016 to prevent the emergence and spread of AMR pathogens in humans and animals (*5,20*).

Zoonotic disease

As most recent emerging and re-emerging infectious diseases are zoonotic, there has been growing emphasis on the significance of zoonotic disease control in public health emergencies (*21*). The ROK designated ten priority zoonotic diseases including anthrax, severe acute respiratory syndrome (SARS), animal influenza with human infection, tuberculosis (Mycobacterium bovis), Enterohemorrhagic Escherichia coli, Japanese encephalitis, brucellosis, rabies, variant Creutzfeldt-Jakob disease, and Q fever with disease-specific guidelines for notification, epidemiological investigations, laboratory diagnosis, and control measures. The KCDC and the Animal and Plant Quarantine Agency (APQA) established the Zoonotic Disease Committee to facilitate information sharing and collaboration for the detection, prevention and response to zoonotic disease events between the human and animal health sectors (2004). The National Institute of Environmental Research (NIER) joined the committee (2017) to apply a One Health Approach for zoonotic disease.

Investigations in animals were carried out by the Ministry of Agriculture, Food and Rural Affairs (MAFRA) and APQA. Laboratory tests for known and novel zoonotic pathogens were carried out by the KCDC/KDCA and the 17 Research Institutes of Health and Environment (RIHEs) for human specimens and by APQA for animal specimens. The Infectious Disease Integrated Management System of the KCDC and the Korea Animal Health Integrated System (KAHIS) of the APQA linked to share animal and human health data (*5,10*).

Biosafety and biosecurity

The KCDC/KDCA regulated the human pathogens under the Infectious Disease Control and Prevention Act and the Act on the Promotion of Collection, Management, and Utilization of Pathogen Resources. The MAFRA regulated animal pathogens and plant pathogens under the Act on the Prevention of Contagious Animal Diseases, the Plant Protection Act, and the Act on the Preservation, Management and Use of Agro-bioresources.

Laboratories and research facilities in the ROK were registered with the government and required to keep biosafety and biosecurity regulations under the jurisdiction of different ministries depending on the biosafety level (BSL) and depending on whether they

are commercial or public facilities with their own guidelines for laboratory biosafety and biosecurity management based on KCDC/KDCA's Laboratory Biosafety Guidelines according to the latest international regulations. Laboratory facilities of BSL 2 and above should designate an institutional biosafety officer and establish an Institutional Biosafety Committee which had the authority to stop the proposed work in case of biosafety or biosecurity concerns. Transportation of select agents was also strictly controlled under the Infectious Disease Control and Prevention Act and the Guidelines for Safe Transport of Infectious Substances. Transportation of high-risk pathogens (HRPs) were required by the approval of the Institutional Biosafety Committee. The ROK government designated several private institutions to conduct biosafety and biosecurity training and provided a budget to fund these activities (*5,22*).

Immunization

In ROK, the National Immunization Program (NIP) started in 1954 under the Prevention of Contagious Diseases Act, designating routine immunization against seven infectious diseases, including smallpox and diphtheria. A total of 20 vaccines were included in the NIP, of which 18 vaccines were provided for free as of 2024. Free vaccination services were expanded to the 19,700 private clinics to tackle financial barriers and improve accessibility from 2014 onwards.

The IT based Immunization Registry Information System enabled real-time monitoring of national or regional immunization coverage as well as the status of vaccine supply. Resident registration information helped identify the number of target people for immunization, thus providing reliable vaccination coverage. The Immunization Registry system shared registration information with relevant organizations.

Since 1995, the KCDC/KDCA operated the National Compensation System for Adverse Events Following Immunization (AEFI) with respect to the NIP. In 2000, the Comprehensive Plan for the AEFI Management was established to support the adverse events surveillance and management system to respond promptly to a serious adverse event.

The ROK cared for foreign residents, who might not have easy access to NIP services, by enabling them to receive free immunizations regardless of possession of an alien registration card and by offering vaccination guidelines in 9 languages nationwide.

The ROK maintained a high vaccination coverage of 95% or above for each vaccine for children. For those who were born in 2013, the fully vaccination coverage for BCG, hepatitis B (HBV), DTaP (Diphtheria, Tetanus and acellular Pertussis) and IPV (inactivated polio) vaccine, which were recommended up to 12 months of age, was 95.9% and 89.2% for 8 vaccines (above mentioned 5 vaccines and MMR, Japanese Encephalitis vaccine) recommended up to 36 months of age. The ROK declared itself measles free in 2006, and, in 2014, was the first nation in the Western Pacific Region to be certified as having eliminated measles (*5,23*).

National laboratory system

The national laboratory system of the ROK consisted of the KCDC/KDCA, Research Institute of Health and Environment (RIHE), and public health centers, where KCDC served as the national reference laboratories. Public health laboratories in 256 public health centers and RIHEs conducted the laboratory testing of infectious diseases and laboratory-based surveillance of the national notifiable infectious diseases in collaboration with the hospitals under the supervision of KCDC/KDCA. As the national reference laboratories, KCDC/KDCA performed the laboratory testing of infectious diseases, quality control and quality assurance of laboratory tests, laboratory-based surveillance, and related training for capacity building. Laboratory testing for 80 national notifiable infectious diseases was performed at public health centers and private sector medical institutions, and the respective costs for laboratory testing were supported as specified in the Infectious Disease Control and Prevention Act.

To control zoonotic diseases, ROK designated major zoonotic diseases as national notifiable infectious diseases. According to the Infectious Disease Control and Prevention Act, the committee for zoonotic disease, composed of experts in public and animal health, was operated. In addition, public human health and animal health laboratories shared data and collaborated for specific diseases on an ad-hoc base through forming consultative groups.

Distribution of public and private sector laboratories was relatively even and easily accessible in all provinces in ROK. The national specimen referral and transfer system was well-established for public health purposes (*5,24*).

Real time surveillance

ROK established an infectious disease surveillance system based on laws/acts. In 2000, the KCDC established an IT-based system capable of reporting in real time, thus ensuring the timeliness and completeness of surveillance data and promoting integration with other surveillance data.

The national notifiable infectious disease surveillance system in ROK had a mandatory surveillance system, and a sentinel surveillance system. 80 types of national notifiable infectious diseases (120 diseases total) were required to be reported in accordance with the Infectious Disease Control and Prevention Act (*5*). The mandatory surveillance system monitors Class 1 to Class

4 infectious diseases. The sentinel surveillance system monitored seasonal influenza, and Class 4 infectious diseases (*25,26*). Since 2016, The MOHW/KCDC imposed private diagnosis laboratories with the duty of reporting notifiable infectious disease pathogens upon their confirmation to prevent delays and unreported cases.

Since the surveillance system was operated through an IT-based system, the reporting of healthcare facilities to local public health centers was shared immediately with provincial governments as well as KCDC/KDCA.

The event-based surveillance system and syndromic surveillance system were in operation to detect potential public health threats. Event-based surveillance collected information from media reports, research papers, and incident reports from healthcare facilities, the Korea-China-Japan network, and inter-governmental information sharing (*27*). A dedicated analysis team integrated indicator-based surveillance data with event-based surveillance data to assess risks and produce reports on a daily, weekly, monthly and annual basis (Figure 1 and Figure 2). Also, the emergency room based syndromic surveillance system was operated in preparation for bioterrorism.

The data gathered through the indicator-based surveillance provided infectious disease statistics to the public in real time through the infectious disease web statistics system, and these data were analyzed on a weekly basis to provide weekly infectious disease statistics through the Public Health Weekly Report (Figure 3). The data collected through event-based surveillance and syndromic surveillance were integrated and assessed for risks and distributed internally, as well as externally with relevant agencies, to transmit timely information regarding infectious diseases that required the attention of the public (Figure 1 and Figure 2) (*5,25-27*).

Workforce development

The KCDC/KDCA was responsible for prevention, investigation, quarantine, testing, and research of infectious diseases. The Department of Public Health and the Research Institute of Health and Environment at the provincial level and public health centers at the district level were responsible for public health services. The KCDC/KDCA had a workforce of about 1,400 people including contracted employees. In local governments, a total of 115 people in 17 provinces, 136 people in 17 Research Institutes of Health and Environment, and 1,181 in 256 public health centers oversaw managing infectious diseases. In particular, the epidemiological intelligence service programme to conduct epidemiological investigations, has operated since 2000 by KCDC/KDCA. There were 102 Epidemic Intelligence Officers (EIOs) in ROK, including FETP trainees. Fifty of them worked at the central government and 46 officers are at the local and provincial levels (*5*).

To foster the public health workforce in ROK, various educational programs are being operated

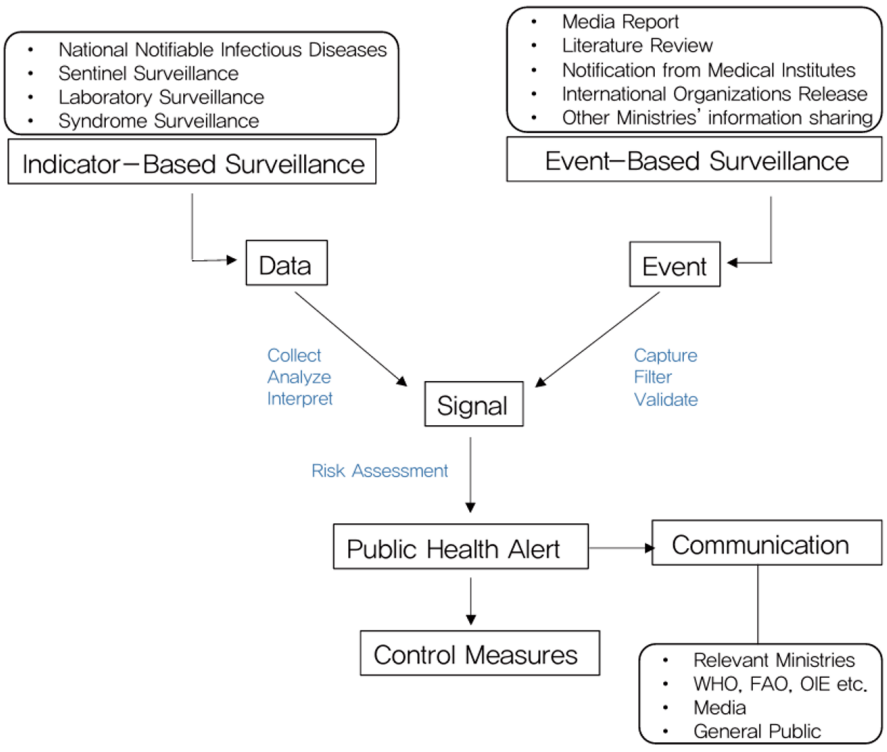

Figure 1. Flowchart of event-based surveillance and indicator-based surveillance. Indicator-based surveillance is a main source of information gathering for risk assessment, but event-based surveillance has its own role as in the early detection of COVID-19.

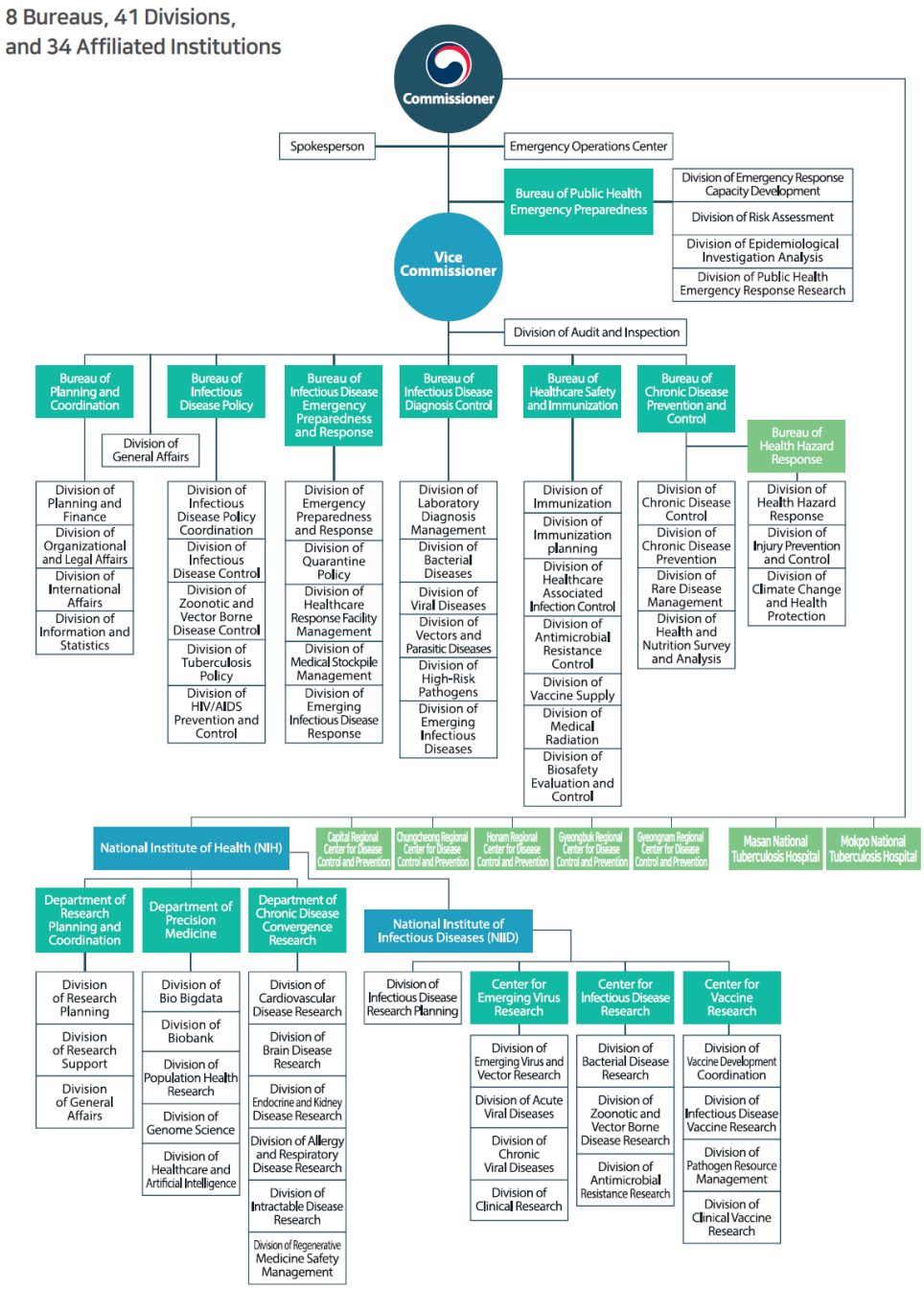

Figure 2. KDCA and its affiliated organizations . KDCA has 8 bureaus and 41 divisions and 34 affiliated institutions. KDCA is a main agency to respond to infectious diseases. It also covers non-communicable diseases and national health and nutritional survey. National Institute of Health (NIH) and National Institute of Infectious Diseases (NIID) are included for research. *Data source: Ref. 37.*

directly or through outsourcing. Typical examples are the public health basic courses operated by the Korea Human Resource Development Institute for Health and Welfare (KOHI), the Field Management Training Program (FMTP) to train personnel in charge of infectious disease management, and the Field Epidemiology Training Program (FETP) to enhance capacity for epidemiology investigation. After the 2015 MERS outbreak, the minimum number of FETP fellows was fixed by law in ROK. Additional medical professionals could be urgently mobilized in addition to healthcare personnel in the public sector, so the capacity to cope with the surge in human resources demand was strengthened (*5*).

Emergency response operations

The Emergency Operations Center (EOC) was established at KCDC in 2016 after the MERS outbreak to support the inter-governmental coordination of information and resources regarding public health emergencies by sharing information on infectious disease

Figure 3. The Public Health Weekly Report (PHWR). PHWR is a weekly publication of KDCA including weekly statistics on the national notifiable infectious disease incidence, policy, and case report launched in 2008. It started with Korean only version, but international requests have made KDCA publish both Korean and English version since 2021. *Data source: Ref. 28.*

events among the relevant ministries/agencies. When the risk of detected events was recognized through a rapid risk assessment as high enough to cause a public health emergency, a MOHW/KCDC internal risk assessment meeting was convened to determine its emergency level in accordance with the Framework Act on the Management of Disasters and Safety and the Standard Manual for Infectious Disease Emergency Management. If the level was determined as Yellow or above, EOC was activated according to the manual. The EOC operation manual has been prepared to specify the procedures for responses to each type of emergency and the roles of the EOC staff in the case of EOC activation. The information system for emergency management was established to enable the EOC to carry out its roles more systematically in the collection and analysis of information, and the supporting of on-site responses (*28*).

Linking public health and security authorities

ROK established Comprehensive Bioterrorism Plan in 2001 to prepare for the threat of North Korea's terrorist attacks to the world and the overall increase in global terrorism risks. Thereafter, manuals and guidelines on bioterrorism were published and are periodically revised. The MOHW announced 8 kinds of biological infectious diseases (Anthrax, Botulinum, Plague, Marburg Fever, Ebola fever and Lassa fever) and established the Infectious Disease Emergency Management Plan in collaboration with the Infectious Disease Control Committee to prepare for large-scale bioterrorism-affected patients in 2016. The Infectious Disease Emergency Management Plan and the Guideline for Bioterrorism preparedness and response against public health emergencies were established.

KCDC/KDCA's Guideline for Bioterrorism Preparedness and Response identified the roles of the central government and local governments in detail for public health emergencies or bioterrorism. KCDC/KDCA jointly conducted a simulation exercise with related ministries every year (*5*).

Risk communication

The KCDC established a dedicated division on risk communication after the 2015 MERS outbreak and published the Risk Communication Guideline for Public Health Emergencies and the Standard Operating Procedure for Risk Communication for Public Health Emergencies, containing details about the risk communication system and strategy, basic principles, communication networks, and evaluation to prepare for emerging infectious diseases.

The risk communication channels for information dissemination included media, Internet, and social networks, and the KCDC/KDCA call center (1339). KCDC/KDCA conducted user-friendly and accessible risk communication by providing various disease information, latest press releases, and content on disease prevention and health information.

KCDC/KDCA monitored major rumors or inaccurate information through the media, Internet, social networking, and 1339 call center. The press releases were disseminated against inaccurate information with reliable information including Q&A sheets were quickly provided through all communication (*5*).

Point of entry

The KCDC/KDCA had 13 quarantine stations (11 quarantine branch offices) installed at airports and seaports nationwide to systemically carry out entry screening toward entrants, along with local governments, and hospitals.

The KCDC/KDCA sent text messages to overseas travelers urging them to report to the KCDC 1339 Call Center if they experienced any symptoms. The quarantine management system that provided travelers' information to medical institutions was to rapidly detect suspected cases and prevent further transmission. When suspected cases were detected at the point of entry (PoE), patients were transferred immediately to nearby hospitals with national designated isolation units. The KCDC/KDCA designated affected areas based on the Quarantine Act, which required travelers to complete a health questionnaire when entering the country.

The KCDC/KDCA established a comprehensive response plan to prepare for and respond to public health emergencies at PoE. The KCDC/KDCA and the Animal and Plant Quarantine Agency (APQA) maintained a cooperative system with the Ministry of Justice and the Customs Service and organize the QIC (Quarantine, Immigration and Customs) institutional council to regularly hold meetings for the exchange of information (*5*).

Discussion

The Global Health Security Agenda developed a new approach to the emerging and reemerging infectious diseases, AMR and biothreats. The global public health emergency can be avoided by preventing avoidable outbreaks, detecting early and responding rapidly to the public health event (*29*). The ROK showed high scores in JEE and SPAR after the 2015 MERS outbreak. Legal basis for case isolation and contact tracing is important and financial compensation during the quarantine period of the suspected cases or contacts with sustainable financing. Conformity to routine vaccination was another predicting factor. For the emerging infectious diseases, early detection and rapid response was a key to containing the outbreak (Table 1 and Figure 4).

Lesson learned from the 2015 MERS outbreak in ROK

An imported case of MERS in 2015 exposed the gaps in the public health system of the ROK. The case visited a primary clinic to a tertiary hospital until he was identified as the MERS infected case. 186 confirmed cases and 38 deaths infected with MERS were a critical failure of the ROK public health system. The KCDC did not detect at PoE the suspected case. The doctors in the hospital and clinics had no information on the patient's travel history and found no clue about this emerging infectious disease. The patients in the emergency room in the tertiary hospital were exposed because there was no triage for respiratory patients with fever. What made the situation worse was the mistrust of the public. The public did not believe what the public health authority said. An epidemilogical investigation to identify contact, contact tracing and quarantine based on mobile phone location and credit card transaction history lacked legal basis (*30*) . The 2015 MERS outbreak was just like what we saw during the COVID-19 pandemic in the world

Reform to the national public health emergency systems in ROK

KCDC has a strong web-based indicator-based surveillance system, or integrated Public Healthcare Information System (PHIS) and is used by more than 3,500 health organizations (*31*). KCDC needed to strengthen the event-based surveillance system with risk assessment, which could complement the indicator-based surveillance. KCDC established a new dedicated division responsible for event-based surveillance and risk assessment. The information with risk assessment was

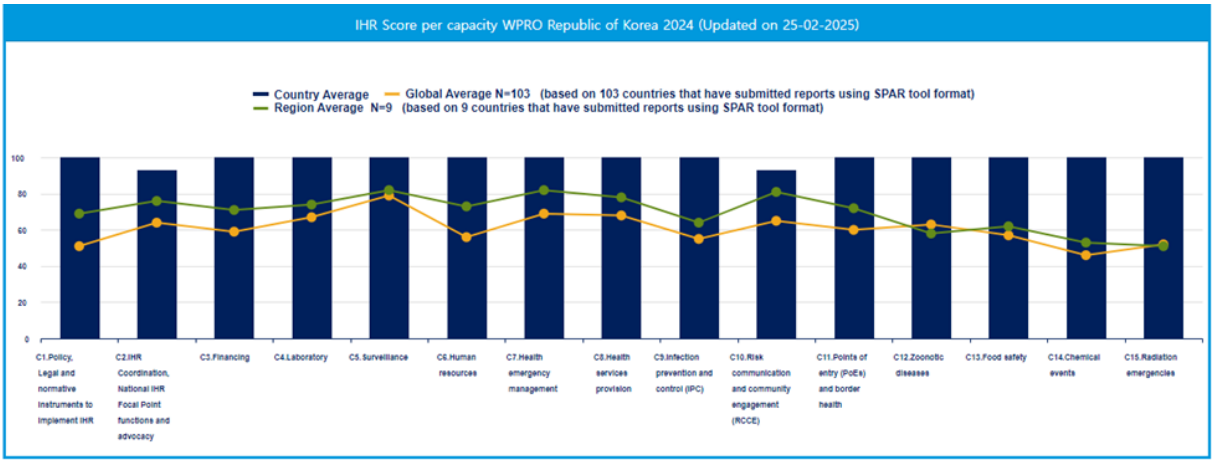

Figure 4. The Republic of Korea's Scores of the IHR States Parties Self-Assessment Annual Report (SPAR) in 2024. ROK has developed and sustained the IHR core capacities scores compared to the global average in all 15 SPAR technical areas.

distributed to relevant ministries/agencies and medical doctors. Together with the Korea Medical Association, the division published a weekly report on overseas emerging infectious disease (Figure 1 and Figure 2) (*27*).

MOHW/KCDC revised the legal gap in contact tracing by revising the Infectious Disease Control and Prevent Act not to violate the personal information law by inserting special situations of infectious disease outbreak so that mobile phone location and credit card transaction history can be traced on a concrete legal basis (*17*). The dedicated risk communication which hired former journalists and public relation experts contributed to enhancing the credibility of KCDC activities (*5*).

Lesson learned from COVID-19 pandemic in ROK

KCDC detected an outbreak in Wuhan on December 31, 2019 through its event-based surveillance system and communicated with China IHR National Focal Point (NFP) to request information on this and shared information on diagnostics and epidemiological investigation with Japan, Taiwan and Thailand with several risk assessments (*19*). KCDC detected the first imported case at a point of entry on January 20, 2020 and conducted case isolation and contact tracing with its advanced ICT technology (*32*). ROK's IHR NFP in KCDC/KDCA notified the information on foreign national cases and contacts detected in ROK or in the inbound flights to the relevant IHR NFPs and ships (*33*). The KCDC shared contact tracing strategy and experience with the United Kingdom Health Security Agency (*10*), and worked together with the United States (US) Department and Human Health Services and US Centers for Disease Control and Prevention for establishing a global health security office (*22,23*). The KDCA hosted the GHSA ministerial meeting in Seoul (*33*) and announced the launching of the Global Health Security Coordination Office in 2022 (*34*). The KDCA actively has taken a leader role in global health security during the COVID-19 pandemic and in a post-COVID-19 era (*35*).

KCDC has developed a mid-and long-term preparedness and response plan for emerging infectious diseases. The key tasks include: *i*) Proactively preparing for and responding to infectious disease outbreaks, *ii*) Controlling and eliminating infectious disease risk factors, *iii*) Preparing for disease and protecting vulnerable groups for healthcare in the super-aging society, *iv*) Enhancing national health care research capabilities, and *v*) Leading global public health cooperation (*35*).

In conclusion, the establishment of KCDC/KDCA showed a significant advancement in global health security because it strengthened South Korea's capacity to respond to infectious diseases while fostering collaboration, innovation, and preparedness at both regional and global levels. In an era where infectious diseases has no borders, the KCDC/KDCA's role is integral to safeguarding public health worldwide.

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