

RESEARCH

Open Access



# Toward better pandemic governance and preparedness: South Korea's whole-of-nation approach to COVID-19

Shin Ae Hong<sup>1\*</sup>

## Abstract

**Background** The profound impact of coronavirus disease (COVID-19) has led to an increased demand for sustainable pandemic governance practices. This study explored emerging hybrid governance practices that provide robust evidence on how to address the complex challenges of pandemics effectively. South Korea, which was severely affected by COVID-19, has implemented a novel governance approach using a whole-of-nation (WoN) model. This hybrid pandemic governance approach, which integrates both whole-of-government and whole-of-society approaches, has enabled synergistic and cohesive multi-sectoral coordination among all stakeholders (public authorities, private enterprises, and civil society) to address multifaceted challenges collectively and strengthen their resilience capacity. This study investigated South Korea's WoN practices and their embedded context and identified key governance enablers facilitating this approach.

**Methods** This study employed a case study design based on an extensive analysis of policy and program documents, drawing on South Korea's publicly available data from January 1, 2020 to March 30, 2023. It assessed six system-level collaborative pandemic governance practices and key enablers, all of which were intended to fortify the country's pandemic response.

**Results** The primary areas of the country's WoN governance practices for COVID-19 control were (i) whole-of-government policy-making and response, (ii) COVID-19 testing system, (iii) digital surveillance of COVID-19, (iv) COVID-19 triage and treatment system, (v) domestic vaccine production, and (vi) community engagement. Key governance enablers for implementing the WoN model were establishing a legal foundation, ensuring decisive and strong governance and leadership, increasing public investment, applying a whole-of-health approach with augmented investment in public health, enhancing crisis communication, and mobilizing local leaders and civil society organizations in the national public health response.

**Conclusions** In exploring innovative approaches to pandemic governance for increased efficacy, responsiveness, and impact, the WoN approach emerged as highly relevant. This example of emerging practice allows policy-makers to re-evaluate their governance strategies and initiatives to improve multi-agency partnerships across the country in their pandemic-preparedness planning.

\*Correspondence:

Shin Ae Hong  
shongk.153@skku.edu

Full list of author information is available at the end of the article



© The Author(s) 2024. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

**Keywords** COVID-19 outbreak, Public health response, Health policy, Governance, Operational strategy, Preparedness

## Introduction

South Korea's (hereafter Korea) pandemic response to coronavirus disease (COVID-19) garnered international attention. Korea was one of the first countries to be affected by the viral outbreak, owing to its geographical proximity and extensive trade and tourist flows with China. However, it effectively managed the pandemic and maintained a remarkably low COVID-19 fatality rate of 0.07% during the initial devastating outbreaks. This is in stark contrast to the rates of 19.83% in the United Kingdom, 9.62% in Italy, 7.39% in France, and 6.37% in the United States [1]. Korea achieved these objectives without shutting down its economy or resorting to harsh lockdowns that could have triggered an economic downturn or social distress. Amid a global vaccine shortage in 2021, Korea administered the fastest rollout of COVID-19 vaccines and attained high coverage, with 94.3% of citizens aged  $\geq 12$  years completing their second dose and 80% of adults ( $\geq 18$  years) receiving additional booster shots [2, 3]. Published studies on Korea's response to COVID-19 demonstrated that strong public institutions enabled early pandemic alerts and the development of rapid response plans (e.g., state-of-the-art technology-driven testing, tracing, quarantine, and treatment protocols) [4–6]. Moreover, they steered private sector pandemic governance (e.g., development of test kits, digital tracing apps) and public investment to bolster recovery (e.g., social safety net expansion for unemployment and comprehensive financial support packages for low-income individuals and marginalized groups) [7–9]. We concur with these assessments. However, these findings highlight a gap in the scholarly discourse surrounding the rise of hybrid governance modalities in health systems to better respond to intricate planetary health crises. Specifically, previous research has tended to oversimplify their lessons by focusing largely on effective policies, technological applications, and organizational efficiency enhancements. Importantly, this study diverges from this tendency and delves into the governance process, focusing on the interplay between multiple autonomous actors from the public service, private sector, and civil society and their collaborative efforts to achieve public health through the lens of the whole-of-nation (WoN) governance framework. At the onset of the pandemic, Dr. Tedros Adhanom Ghebreyesus, Director-General of the World Health Organization (WHO), stressed the need for member states to adopt national strategic plans encompassing whole-of-government (WoG) and whole-of-society (WoS) approaches [10]. Globally, policy-makers have consistently called for new collaborative, responsive, and outcome-based models of public health

governance [11, 12]. The COVID-19 pandemic has accelerated the development of innovative, adequate, and sustainable health system governance models to address transnational challenges and enhance public health. This study explores Korea's novel pandemic governance practices in terms of six system-wide partnership areas, employing a hybrid WoN strategy that integrates the WoG and WoS approaches and their embedded context. It also identifies key governance enablers instrumental to the successful implementation of WoN practices to provide insights on how best to assist other countries in developing practical public health governance strategies.

## Methods

### Context

This study adopted a qualitative approach to understand how and why hybrid governance can perform better in managing intricate crises such as the COVID-19 pandemic [13–15]. Specifically, it explored the dynamics of the hybrid nature of collaborative governance practices, including policy planning, implementation, multi-sectoral partnership, networked joint action, and interoperability, and how they complement each other in the system to produce more responsive governance performance and improve public health outcomes during COVID-19 [13, 14, 16–18].

Yin's case study approach was used to investigate contemporary phenomena [15]. The case study design is useful because it has been proven to provide a clear and systematic depiction in its real-world context and addressing the nuanced questions of "how" and "why" inherent in the research inquiry. Employing a qualitative single-case study methodology, this study captures the full picture of the complex dynamic phenomena involved in collaborative governance arrangements and offers a holistic analysis of policies, institutions, actors, and their respective roles in tackling the pandemic. Through the analysis, we learned how and why such a governance mechanism, as a policy strategy capable of harmonizing macro- and micro-level endeavors, contributes to better outcomes.

### Data collection and analysis

The data collection process involved an extensive review of documents spanning January 1, 2020, to March 30, 2023, with a focus on understanding collaborative governance practices during the COVID-19 pandemic. A diverse range of government policy documents, including internal ministerial documents, daily briefings, situational reports, news reports, correspondence, databases, surveys, and web content pertaining to the COVID-19

response were systematically collected. In addition, a consistent search was conducted for policy documents issued by key government entities actively involved in collaborative arrangements, such as the Korean government's Central Disaster and Safety Countermeasures Headquarters (CDSHQ), the Ministry of Health and Welfare (MOHW), the Korean Disease Control and Prevention Agency (KDCA), the Presidential Office Broadcast, and local governments. In particular, the CDSHQ assumed a leadership role in orchestrating coordination among the various stakeholders with a commitment to achieving national policy outcomes. Recognizing its central position in shaping the WoN governing framework and delineating responsibilities among the government, market entities, and local communities, this study monitored its routine reports, briefings, and policy documents, along with other relevant policy documents issued by various governmental bodies.

Data on the coordination process and impact involving institutes, enterprises, social groups, and non-profit organizations in the pandemic prevention process were obtained primarily from publicly available data, including reports, surveys, news media reports, web content, and gray literature produced by organizations. In the context of emergency response, the private sector is a vital participant and indispensable counterpart in the collaborative process that links governmental entities in terms of information sharing, logistical support, infrastructure, and resource acquisition. To ensure the reliability of the data for understanding the collaborative mechanism and the division of responsibilities between these entities, a scoping search was conducted using thematic keywords such as “command and coordination” AND “collaborative governance” AND “state-society partnership,” “epidemic prevention and monitoring” AND “health promotion” “stakeholders” AND “cooperation” OR “partnership,” AND “social groups” OR “experts” AND “logistic support” in the Web of Science, ScienceDirect, Scopus, and Factiva databases. Inclusion and exclusion criteria were developed from the literature review to identify the most relevant papers. Studies unrelated to COVID-19 policies, programs, and action plans and those not focused on the nation's broad collaborative governance process were systematically excluded. Meanwhile, studies addressing pandemic management, the public health system, early detection and treatment of COVID-19, and public-private partnership strategies and initiatives were incorporated into the analysis. The most relevant studies were reviewed after evaluating their relevance and removing duplicates. Through extensive document analysis, insights were gained into Korea's institutional design and practice of collaborative interventions for the nation's COVID-19 response; ultimately, six pivotal areas of WoN

practice and key governing enablers that enhance overall pandemic management were identified.

## Results

This study identified six major features that contributed to Korea's notable, robust WoN governance practices:

- (1) WoG policy-making and response,
- (2) a COVID-19 testing system,
- (3) digital contact tracing of COVID-19,
- (4) a COVID-19 triage and treatment system,
- (5) domestic vaccine production, and,
- (6) community engagement.

Key governance enablers necessary for successful implementation of a WoN model include (i) the establishment of a legal foundation to enable coordination mechanisms in the national public health response; (ii) the existence of decisive and strong governance and leadership to direct rapid and coordinated action; (iii) an increase in public investment for economic recovery and social protection; (iv) the application of a whole-of-health approach, along with an augmentation of public health investment; (v) the enhancement of crisis communication through a centralized campaign and coordinated communication response; and (vi) the mobilization and engagement of local leaders and civil society organizations (CSOs) to build an optimal response structure for meaningful impact. These findings can provide valuable guidance to countries grappling with the effective implementation of government decisions during the pandemic, as they endeavor to adapt different governance approaches to their unique contexts and glean potential lessons for formulating practical and enduring public health governance strategies to achieve better outcomes. The [discussion](#) section offers insights into how other governments can incorporate this framework into their policy-making and operational practices. With these objectives in mind, this study takes an integrated view of the Korean government's response to the pandemic.

## Discussion

### Korea's whole-of-nation initiative in context

In response to COVID-19, Korea swiftly implemented WoN governance measures from the onset. The governance structure and socio-political context served as central building blocks for policy development. Guided by a centralized administrative framework and facilitated by a socio-political context with a longstanding tradition of harnessing private sector capabilities to achieve developmental goals for public goods, Korea was able to successfully formulate and manage plans for its COVID-19 response. These coordinated efforts were also motivated by financial incentives and stakeholder needs. In practice,

during a pandemic-induced economic downturn, Korea's top-down crisis management not only directed tasks or activities to the private sector but also provided adequate financial resources to execute these tasks, ensuring that resources were allocated to local governments, the private sector, and citizens commensurate with the severity of the situation, thereby enabling joint capacity [19]. Such governance mechanisms and policies, rooted in shared norms (e.g., valuing devotion, interdependence, conformity, and coproduction) and supported by necessary resources, enabled the nation to create a favorable platform for actors to accept and engage in mutually beneficial interactions aimed at achieving common goals.

### **Whole-of-government policy-making and response**

To draw applicable insights and lessons from Korea's response strategies, it is crucial to understand the embedded political context that shapes the nation's policy actions. Politically, Korea is a democratic unitary country with a relatively brief history of decentralization achieved through local elections in 1995. Despite this political decentralization, the country has retained a centralized administrative approach [20]. Unlike Western federal or decentralized governance structures, Korea's unitary political system centralizes power within the national government. Consequently, while the central government takes the lead in developing national response strategies, local governments—constrained by limited autonomy and resources—largely follow the directives of the center, implementing national initiatives on the ground as the primary enforcers of these policies.

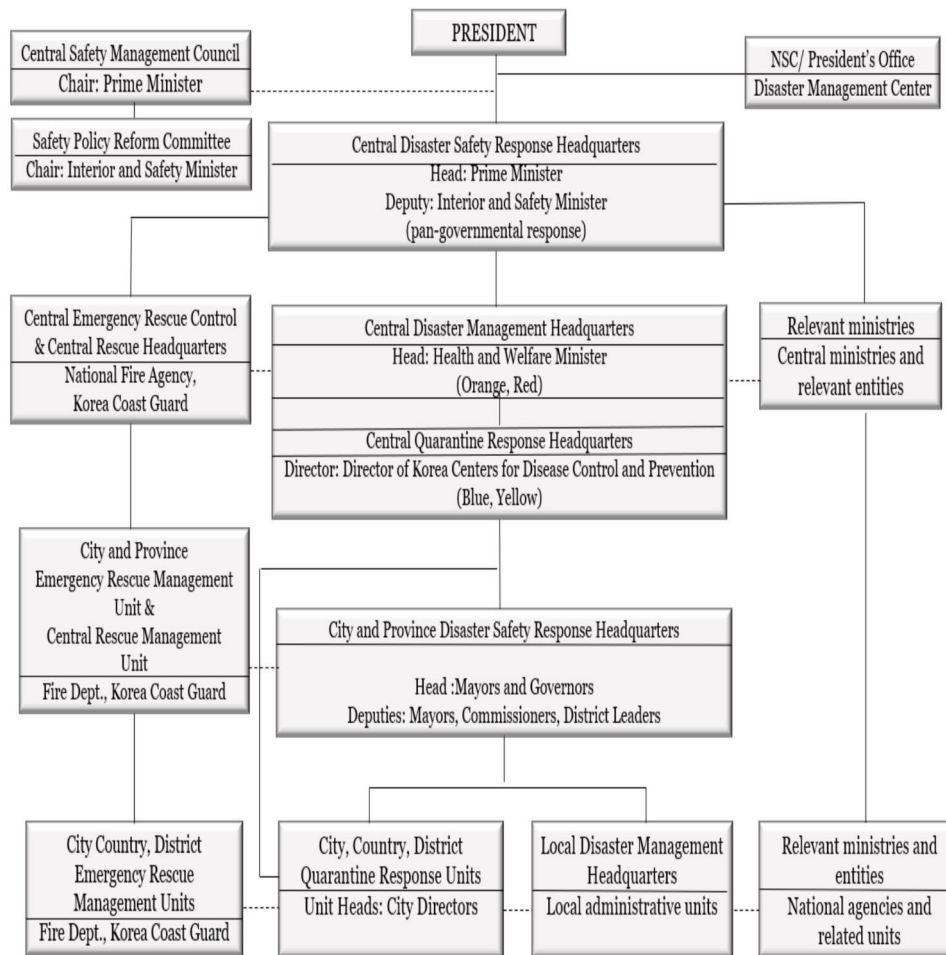
Centralized governance prevails in the context of public health in Korea. The government enacts laws for epidemic control and prevention, featuring comprehensive pan-governmental cooperation systems in accordance with the Infectious Disease Control and Prevention Act (IDCPA). The MOHW is pivotal in designing and updating master plans for national infectious disease management every five years. In response to evolving epidemic challenges, particularly those highlighted by the 2015 Middle East Respiratory Syndrome (MERS) outbreak, the Korean government introduced the second master plan in 2018, which prioritizes the One Health approach emphasizing a robust intergovernmental cooperation system to bolster national disease management capacity [19, 21]. Concurrently, local governments that adhere to the IDCPA, maintain their dual jurisdictional status as sub-central governing bodies. Within this framework, they have proactively implemented and enforced national public health policies in their municipalities [22].

When the COVID-19 crisis warning level was elevated to Level 4, in accordance with the IDCPA (Article 8.5), Korea quickly established a central government policy-making committee to oversee national crisis management

[23]. As illustrated in Fig. 1, a governance structure for managing the COVID-19 crisis was established, with the CDSHQ, chaired by the Prime Minister, serving as the top emergency management body of the government.

The CDSHQ convened regular meetings with national-level actors to develop response strategy guidelines by drawing on national master plans for infectious disease prevention and control. These response strategies emphasized the following main tasks: (1) improving initial response capacity by establishing a rapid, accurate surveillance and epidemiological investigation system; (2) building a technology innovation platform for infectious disease management; (3) securing new technology for diagnostic methods and strengthening testing capabilities at the local government level; and (4) expanding investment in infectious disease R&D and investing in the biotechnology industry centered on disease management; (5) expanding vaccination support and developing domestic vaccine infrastructure; (6) strengthening quarantine measures; (7) improving patient safety and managing medical-related infection; (8) enhancing risk communication and reporting; and (9) adopting a One Health collaborative system with multi-sectoral partnerships [25, 26].

Within the policy framework, the CDSHQ assumed a decisive leadership role, guiding policy actions, while orchestrating a pan-governmental integrated response and overseeing cooperation to fortify WoG initiatives [27]. Policy coordination, information sharing, and communication among central government ministries, relevant entities, local governments, and national rescue control agencies were emphasized as essential operational practices [24]. To ensure an effective public response, necessary resources were dispatched from the Central Disaster Management headquarters as needed. The MOHW and KCDA (i.e., local governments in conjunction with national rescue control agencies) operated within the established chain of command. The MOHW delivered an overview of the epidemic crisis, issued alerts, and provided vital resources to hospitals to ensure optimal patient care. The KDCA oversaw all aspects of quarantine and disinfection efforts and responded promptly to public health threats. It also collaborated with various government agencies, including the Ministry of Land, Infrastructure and Transport, to develop an online epidemic data platform for rapid identification of infection hotspots, and partnered with the private sector to facilitate the development of test kits and domestic vaccines [7, 28]. At the local level, city and country emergency rescue and quarantine units, Local Disaster and Safety Countermeasure Headquarters and other relevant ministries and agencies collaborated to implement a series of 3T (Testing, Tracing, Treatment) policy measures to mitigate community transmission [6, 29]. This WoG



**Fig. 1** Disaster management governance system in Korea. Note Solid lines denote command and reporting lines, and dotted lines represent coordination and support relations. Source Korean Ministry of Education [24]

policy-making and response, tailored to Korea’s unique context, enabled the country to enhance its operational capacity and strengthen the government’s response to the COVID-19 crisis.

**Collaboration across society for the COVID-19 response**

**Agile and comprehensive diagnostic tests for SARS-Cov-2 control**

Current clinical diagnostics for severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) rely primarily on reverse transcriptase-quantitative polymerase chain reaction (RT-qPCR) for nucleic acid identification. With its noteworthy sensitivity, specificity (averaging 87.8%), and high predictive value, it continues to serve as the gold standard for SARS-CoV-2 diagnosis [30]. However, the inherent limitations of RT-qPCR, including the need for specialized laboratory facilities, equipment, skilled personnel, procedural duration, and waiting times, have led to the development of rapid antigen tests (RATs). Although variations in RAT results have been reported to

be contingent on different settings, their overall efficacy has been documented, with pooled sensitivity and specificity values of 68.4% and 99.4% (95% CI), respectively [31]. Employing a combination of both methods is often recommended to obtain rapid and reliable test results, thereby capitalizing on the complementary strengths of each approach [32].

After COVID-19 was declared a highly communicable disease in Korea, the government implemented an aggressive testing strategy with meticulous contact tracing. It achieved effective control of COVID-19 nationwide through extensive testing of 475,619 suspected cases, resulting in the detection of 17,858 positive cases (3.75%) by April 9 [33]. RT-PCR tests with an improved assay time of 6 h were developed through coordinated efforts involving the KDCA, Korean Society for Laboratory Medicine (KSLM), and Korean Association of External Quality Assessment Service. The Korean government recognized the need for standardized testing kits and supported a consortium of manufacturers in the development of commercial testing kits. In February 2020,

the Korean Ministry of Food and Drug Safety (KMFDS) granted fast-track approval for use under the Emergency Use Approval System to several testing kits, including Allplex, Power Check, DiaPlex Q, Standard M, and Real-Q, manufactured by biotech companies: Seegene, Kogene Biotech, SolGent, SD Biosensor, and BioSewoom, respectively [34]. In collaboration with both public and private laboratories, Korea swiftly expanded its diagnostic testing capacity, leading to a substantial increase in the number of laboratories performing RT-PCR testing nationwide from 18 to 573 by June 2020 [35]. Concerted collaboration between the public and private sectors effectively streamlined convenient access to diagnostic testing, with diverse specimen collection sites in urban areas, including numerous public and private healthcare facilities, drive-through and walk-through testing stations, and door-to-door testing. Government-sponsored coverage of testing expenses enabled Korea to process up to 850,000 test results daily by January 2022 [36]. By June 15, the nation's extensive network of 8,638 testing sites reported testing more than 100.27 million suspected cases, suggesting that nearly every Korean citizen had been tested at least twice [36, 37].

#### **Digital contact tracing to support COVID-19 surveillance**

During the COVID-19 pandemic, governments worldwide implemented surveillance policies using digital technology tools such as cell phone geolocation, Bluetooth, contact tracing applications, smartwatches, and digital thermometers [38]. However, the deployment of smartphone payment apps (China), tracing apps (Korea, Singapore, Israel, Australia, and the UK), drone-assisted quarantine enforcement (France), wristbands, apps that report quarantine breaches to public health authorities (Taiwan and Korea), and smartwatches that collect biometric data (the US) triggered debates about privacy, civil liberties, ethics, and data ownership [39–41]. In particular, concerns were raised over government surveillance practices and their impact on fundamental values (e.g., freedom of assembly, mobility, or privacy protection) in modern democracies [42]. Nevertheless, the pandemic situation was considered a “state of exception” [43] that necessitated the temporary suspension of existing rights to safeguard citizens' security [44]. The WHO stressed that governments must prioritize alleviating the impact of COVID-19 and adopt efficient outbreak prevention strategies using advanced technologies [45]. During the outbreak, biosurveillance emerged as a critical element of the Global Health Security Agenda [46]. Attitudes toward surveillance technologies implemented for the “public good” generally differ between liberal democracies and authoritarian political systems. In this regard, the key to successful policy in Korea can be seen as voluntary public adherence to health guidelines [47]. Countries such

as Korea, with advanced IT industries, robust digital technology infrastructures, high smartphone penetration rates (97.13%), and digitally literate populations, are uniquely positioned to leverage digital technology to support contact tracing [48]. Comprehensive COVID-19 data were gathered and assessed using the Epidemic Investigation Support System, which was repurposed from the country's existing Smart City Data Hub urban monitoring platforms. The strategic use of private enterprises, such as Naver, KakaoTalk, KT, SK, and LG Uplus ensured the deployment of a digital contact tracing tool for the general public.

In collaboration with the private sector, the government introduced a range of disciplinary digital sensing and surveillance tools to implement a 3T strategy. Given the high rate of smartphone ownership in Korea, app-based digital tracing was widely used. The KI-Pass and QR code ID, Corona 100 m, COVID-19 Fact, Corona Map, and Corona Path app services enabled users to identify potential routes of virus transmission. The apps notified individuals in contact with suspected cases, facilitating timely testing [49]. After receiving an isolation or quarantine notice, individuals were required to use a Self-Quarantine Safety Protection app daily to report their health status and quarantine compliance to the relevant authorities; any deviation from the specified parameters triggered immediate alerts and prompted location verification. This significantly improved data reliability and precision, thereby augmenting epidemic intelligence operations during the pandemic.

#### **COVID-19 triage and treatment system for optimal patient care**

During a large-scale viral outbreak, resilient healthcare systems must manage the immediate crisis while ensuring continuity of vital medical services [50, 51]. To reduce nosocomial transmission and optimize care with limited resources during the COVID-19 pandemic, Korea used a range of measures to enhance screening procedures, including tiered patient management, mobile apps, online programs, local respiratory care clinics, COVID-19 facilities, and exclusive COVID-19 care hospitals. The triage method expedited diagnosis using clinical symptoms, diagnostic tests, and radiological assessments [52–54]. Most Korean hospitals adopted a two-tiered triage protocol, with initial screening at the clinic entrance based on travel, contact history, and symptoms, followed by secondary reassessment by nurses within individual departments, and finally referral of patients if symptoms or epidemiological history emerged [55]. Categorization of patients according to severity-guided treatment was based on the Korean COVID-19 treatment guidelines, which consider treatment efficacy and regional medical conditions [56]. A public–private partnership between

the Ministry of Health, medical facilities, and the private sector further bolstered Korea's triage system, enabling effective public screening. Extensive RT-PCR testing detected 12.28% of infections and allowed immediate implementation of care or quarantine measures [57]. The Doctor Now project, initiated by healthcare institutions, ensured secure, effective, and timely patient care for individuals in home quarantine using apps or online platforms, providing access to medical services and condition evaluation prior to potential hospital transfer [58]. Additionally, Respiratory Specialty Clinics were established in communities for patients with mild symptoms (e.g., allergic rhinitis to chronic bronchitis) in collaboration with the Korean Medical Association, the Korean Hospital Association, and public health centers [59]. Patients with moderate COVID-19 who did not require oxygen treatment but needed active monitoring were managed at community treatment centers staffed by medical professionals, which were established by repurposing private facilities. This was facilitated by the cooperation among companies, organizations, and institutions, such as Samsung, LG, Hyundai, Kia, the Catholic Church, and universities, thus fortifying the nation's triage capacity. In cases of disease progression, antiviral treatments (e.g., remdesivir, ritonavir-boosted nirmatrelvir, or molnupiravir) were administered according to treatment guidelines to inhibit viral replication, respiratory deterioration, and hospitalization [56, 60].

For severe cases, the MOHW designated 69 hospitals nationwide as new infectious disease hospitals, supported by \$31.6 million in funding [61]. Critical cases were determined based on the presence of dyspnea, respiratory failure, or multi-organ dysfunction. Hospitalized patients received therapeutic regimens that included antiviral treatments (e.g., paxlovid, remdesivir, or regkirona), immunomodulators (e.g., dexamethasone or tocilizumab), and anticoagulants (e.g., venous thromboembolism prophylaxis) [56, 60, 62]. Korea significantly strengthened the ability of its medical infrastructure to manage the pandemic through collaborative and systematic COVID-19 triage and treatment efforts, effectively providing simultaneous care to both the general population and patients with COVID-19 while minimizing mortality.

#### **Expanding local manufacturing capacity for COVID-19 vaccine**

Amid the global scarcity of COVID-19 vaccines, Korea faced challenges in achieving its goal of vaccinating 70% of its population by September 2021. Under this shortage scenario, it implemented three procurement strategies: (1) bulk purchasing directly from manufacturers or through COVAX before the completion of clinical trials, (2) expanding domestic vaccine production, and (3)

engaging in vaccine swaps with nations with sufficient vaccine supplies [63]. Nevertheless, the limited vaccine supply resulted in delays in the rollout of the first dose, which began in late February 2021, trailing behind several high-income countries. To address this, the government proposed a number of vaccine allocation strategies, including prioritized vaccination, delayed dose intervals, and digital apps to redistribute unused vaccines [63]. Vaccine shortages and inequities in access, high costs, and delayed shipments from foreign manufacturers accentuated the need for domestic vaccine production. Local vaccine manufacturing was needed to ensure a stable vaccine supply, reduce costs, increase sustainability, and create future export opportunities. Accordingly, the National Assembly of Korea allocated \$2.22 billion and ratified a supplementary budget of ₩3.7 trillion to the MOHW for vaccine development [64]. This enabled Korea's leading pharmaceutical companies to embark on research and development programs for COVID-19 vaccines, while swiftly establishing a local vaccine industry to augment the country's manufactured vaccines by 2025.

With the MOHW's support, manufacturers signed contractual agreements with their foreign counterparts to manufacture millions of doses of COVID-19 vaccine annually in Korea. SKYCOVINE, the first homegrown COVID-19 vaccine developed by SK Bioscience, was the first to be approved by the KMFDS and used in a national vaccination campaign [65]. Moderna's Spikevax® COVID-19 vaccine, produced by Samsung, was also approved by the KMFDS for use in Korea's mass vaccination campaign. Korea's biomanufacturing industry aimed to produce billions of doses of COVID-19 vaccine annually to supply Europe, Asia, and Africa [66]. Through a robust public-private partnership, the country made significant progress in accelerating vaccine development and production. These efforts extended beyond addressing the current COVID-19 crisis to strengthen the nation's preparedness for future pandemics.

#### **Building community engagement in the COVID-19 pandemic response**

Proactive and strong community engagement played a crucial role in strengthening the implementation of Korea's COVID-19 response, as diverse community stakeholders actively contributed their expertise, shared responsibility, and meaningfully participated in effective pandemic response. To ensure inclusivity in COVID-19 policy design, the Korean government employed public hearings and online platforms to foster connections between the community and government, which facilitated the introduction of initiatives to address public concerns, such as the Public Mask App and Personal Safety Number [67, 68]. To further strengthen community engagement and partnerships, the government actively

engaged in public–private debates through various online and offline public hearings and policy briefings. It addressed concerns related to equity and distributive justice, and considered the challenges healthcare professionals faced in dealing with high patient volumes, persistent exposure to the virus, long working hours, inadequate resources and personnel, and marginalized communities seeking essential services to meet their basic needs [69, 70]. Such dynamic debates within Korean society fostered greater social inclusiveness in policy development, resulting in expanded and adapted public investment policies that better addressed the public's need for access to goods and services, which, in turn, fostered more active public engagement in public policy [71].

Various entities in Korea actively contributed to pandemic mitigation measures: charitable organizations (e.g., Community Chest of Korea, Beautiful Foundation, Child Fund of Korea, and World Vision); religious organizations (e.g., Catholic Bishops' Conference of Korea, the Yoido Full Gospel Church, and the Korean Red Cross); professional associations (e.g., the Korean Medical Association, the Korean Psychological Association, the Korea Association of Regional Public Hospital); educational institutions (e.g., the Yonsei, Korea, Kyonghee, Sungsil, and Catholic Universities); cultural figures (e.g., celebrities, singers, and artists); and corporations (e.g., Samsung, LG, and GE Korea). They fostered awareness of infection control and prevention protocols (e.g., promoting self-imposed social distancing and travel restrictions, setting up hand hygiene stations, and supporting national COVID-19 immunization campaigns) and provided resources to at-risk populations (e.g., donating money to provide food and supplies to vulnerable groups and medical staff). They also participated in contact tracing (e.g., ensuing record management and monitoring movement activities) and offered expertise to combat COVID-19 (e.g., free professional counseling services for COVID-19 depression and public policy suggestions on COVID-19 management) [72].

### Factors enabling whole-of-nation practice

During infectious disease outbreaks, effective crisis control and mitigation of negative impacts hinge on the national government's policy response. To advance the WoN policy approach, the implementation of system-level governance practices requires national governments to proactively plan and execute initiatives on the ground, thereby fostering collaborative governance arrangements, dynamics, and actions across levels, boundaries, and interests. The Korean government is dedicated to improving public health legal preparedness, and ensuring robust leadership, augmented government budget allocation to the public and health sectors, risk communication, and active engagement with local communities to

develop WoN practices as a policy strategy to address the COVID-19 crisis.

These key drivers played a substantial role in constructing WoN governance arrangements in Korea. Moreover, several other countries that adopted similar policy strategies in their COVID-19 response also experienced increased effectiveness of their coordination measures. For instance, Taiwan, Singapore, and China, with robust public health legal preparedness and strong central leadership, demonstrated superior pandemic governance efficiency, enabling WoG coordination essential for prevention and control [73, 74]. Conversely, countries with insufficient legal preparedness and decentralized governance mechanisms (e.g., the US, the UK, Italy, and India), where local governments have greater policy-making freedom, faced challenges in formulating a timely and unified national strategy for an effective pandemic response [75–77].

Additionally, countries such as Taiwan and Singapore implemented policies aimed at strengthening collaborative capacities and processes through increased public spending and health investment, adept risk communication, and strong community engagement, all of which greatly elevated stakeholder participation in national response measures [74, 78]. In contrast, countries lacking these qualities, such as low-resource countries with inadequate resources for public and health systems (e.g., African countries) or weak risk communication management and community engagement practices, as seen in some Western liberal democracies that value civil rights, freedom of expression, individualism, and promoting self-governing capacity (e.g., Sweden, the US, the UK), encountered challenges in generating whole-community collaboration in their pandemic response operations [79–81]. Table 1 illustrates a comparison of the WoN enablers in the COVID-19 response in six countries.

As shown in the table, countries with WoN attributes were more successful in managing the pandemic than those without. As countries prepare for the next pandemic, they should prioritize the implementation of essential measures, particularly those that align with the WoN attributes that ensure preparedness, prevention, and control. Notably, these enablers helped Korea achieve a greater WoN response in addressing the COVID-19 crisis. Based on the lessons learned from the MERS outbreak, the Korean government refined its pandemic policy approach [19, 21, 24]. Remarkable progress was made during the COVID-19 crisis as the government forged strong collaborative partnerships beyond the healthcare sector. The efficacy of Korea's response is also underscored by the adept use of pandemic guidelines and principles. Conversely, the potential weakness of the US and UK pandemic approaches may be due to the structural challenges of public health governance, particularly the



**Table 1** Comparison of six WoN governance enablers in the COVID-19 policy response

Countries	Public health legal preparedness	Robust leadership	Public spending	Public health investment & WoN approach	Effective risk communications	Community engagement
US	Ñ	Ñ	•	Ñ		
South Korea	•	•	•	•	•	•
UK	Ñ	Ñ	•	Ñ	Ñ	
Taiwan	•	•	•	•	•	•
Singapore	•	•	•	•	•	•
Nigeria	Ñ		Ñ		•	•

Note represents a high-level presentation; Ñ denotes indicator is presented but at an insufficient level

Source Compiled from various sources [73, 74, 79, 81–87]

lack of enforcement mechanisms. However, it is crucial to note that even in this context, countries can enhance their performance by adhering to the principles outlined in the guidelines developed through years of policy planning. For instance, the US is well equipped with the Crisis and Emergency Risk Communication (CERC) framework for public communication, which was designed to facilitate effective risk communication during the COVID-19 pandemic. However, administrative and public health authorities failed to reframe their approaches in accordance with the CERC guidelines [81]. In such cases, to effectively address new complex challenges, countries must revisit their core principles and strive to address potential lapses in stringent adherence to these overarching guiding principles. Meanwhile, in the long term, by drawing insights from countries with effective pandemic management, nations can strategically develop and adopt policy plans to reduce conflict between central and local governments, foster collaborative partnerships across various levels of government, and work across organizational boundaries to involve the private sector, thereby enhancing overall pandemic response capabilities.

**Whole-of-nation enablers: Korea**

During the COVID-19 crisis, Korea focused on strengthening the following six areas to enhance its WoN response and effective operation:

***Establishing a legal foundation to enable coordination mechanisms in the national public health response***

Legal preparedness for public health formed the backbone of Korea’s COVID-19 response. The IDCPA provides a legal basis for intervention, resource mobilization, and facilitation of coordinated nationwide responses through various legislative tools. After the IDCPA declared COVID-19 an infectious disease, the KDCA conducted testing, tracing, and quarantine according to the procedures stipulated in Article 16. The CDSHQ was designated as the central authority to lead and facilitate the formation of a systemic COVID-19 response in accordance with Article 8.5. The Act also requires local

governments, health communities, the private sector, and citizens to support public health measures and engage in public–private partnerships as part of the epidemic response (Articles 4–6).

***Requiring decisive, robust and effective leadership to direct rapid and coordinated actions***

The CDSHQ was established to centralize public health interventions and promote interagency cooperation. Under its leadership, all government agencies have been coordinated to enhance the national public health response. The CDSHQ operates as a high-level central authority that organizes a multi-sectoral response involving different systems for national risk management.

***Increasing public investment for economic recovery and social protection***

During the COVID-19 outbreak, the Korean government increased expenditures through four additional budgetary provisions. Financial assistance of ₩8.13 trillion was allocated to support the public, including merchant and employment support, relief packages for vulnerable groups, and local economic recovery. Additionally, the 2022 budget of ₩604.4 trillion helped support economic revitalization through recovery efforts, digitalization, and enhancing public welfare and security [8]. This fiscal stimulus contributed significantly to economic recovery, mitigating the impact of the pandemic and ultimately fostering broader public cooperation for a coordinated national response.

***Applying the whole-of-health approach and increasing public health investment***

Korea’s whole-of-health response enabled effective rapid testing, surveillance, tracing, isolation, and healthcare provision, which, in turn, allowed services to adapt to the needs of COVID-19 patients through telemedicine, temporary respiratory clinics, and e-care platforms. Additionally, public health resilience capacity was bolstered by investments, including reimbursement to medical facilities treating patients with COVID-19 (₩1,863 billion),

infection prevention and control efforts (₩844 billion), self-quarantine and treatment expenses (₩534 billion), and port surveillance, diagnosis, and research (₩338 billion) [88].

#### ***Enhancing crisis communication through centralized campaigns and coordinated communication responses***

Korea enhanced its crisis communication response through a centralized, coordinated campaign. Risk communication was prioritized to ensure the timely dissemination of accurate and up-to-date information to address public concerns and counter the spread of misinformation [89]. In this regard, the CDSHQ played a crucial role in establishing a centralized and coordinated public campaign. Through this platform, public health messages are effectively aligned across all government directives. The centralized campaign further intensified messaging, influencing public behavior toward measures such as social distancing, wearing masks, and immunization.

#### ***Mobilizing and involving local leaders and CSOs to build optimal response structures to achieve impact***

Strong partnerships were formed between the Korean government and various social sectors, including expert groups, media, non-governmental organizations, religious organizations, influencers, and individuals. This WoS approach fostered the development of a bottom-up response and amplified the campaign's impact. Academic organizations, such as the KSLM, the Korean Society of Infectious Disease, and the Korean Society of Preventive Medicine, provided expert guidance and worked with various governments to develop targeted disease control initiatives with various governments. Other CSOs, such as the Korean Red Cross, the Korean Disaster Relief Association, and the Community Chest of Korea, leveraged their platforms to promote government campaigns. Therefore, an optimal response structure was established through strategic partnerships with community stakeholders.

#### **Conclusions**

The substantial impact of COVID-19 on human society challenges us to move away from conventional ways of thinking and to envision innovative and sustainable governance approaches within healthcare systems that can bolster pandemic preparedness. This study aims to foster contemplation and discourse on the development of innovative and sustainable governance strategies in healthcare systems to enhance preparedness for future pandemics. In particular, Korea's hybrid WoN governance strategy, which integrates the WoG and WoS approaches, was pivotal in enhancing the resilience of the public health system during the unprecedented global crisis of the COVID-19 pandemic. Six areas of WoN governance

arrangements dedicated to improving national infectious disease management were examined: (i) WoG policy-making and response, (ii) the COVID-19 testing system, (iii) digital contact tracing of COVID-19, (iv) the COVID-19 triage and treatment system, (v) domestic vaccine production, and (vi) community engagement. Implementing a WoN approach is undeniably challenging. Nevertheless, this study identified the key enablers that facilitate its operation. These include (1) establishing a legal foundation to enable coordination mechanisms in the national public health response, (2) requiring decisive and strong leadership to direct rapid and coordinated action, (3) increasing public investment for economic recovery and social protection, (4) applying a whole-of-health approach and increasing public health investment, (5) establishing crisis communication through a centralized campaign and coordinated communication response, and (6) mobilizing and involving local leaders and CSOs to build optimal response structures to achieve impact. In light of this nuanced discussion, it is suggested that in exploring innovative approaches to pandemic governance for increased efficacy, responsiveness, and impact, a WoN approach becomes relevant and critical to future debates on health system governance, particularly in preparing for future global health crises. This study highlights the unique governance response of a particular country (Korea) and identifies the six key facets of its holistic governance practices that have established effective governance arrangements. Future empirical studies could extend this study by investigating the applicability of Korea's governance approach to other political and administrative contexts. Comparative assessments across institutional frameworks can provide valuable insights and enhance the understanding of pandemic governance responses at the global level.

#### **Abbreviations**

WoN	Whole-of-nation
WoG	Whole-of-government
WoS	Whole-of-society
WHO	World Health Organization
CDSHQ	Central Disaster and Safety Countermeasures Headquarters
MERS	Middle East respiratory syndrome
MOHW	Ministry of Health and Welfare
KDCA	Korean Disease Control and Prevention Agency
CSO	Civil society organization
IDCPA	Infectious Disease Control and Prevention Act
RATs	Rapid antigen tests
KSLM	Korean Society for Laboratory Medicine
KMFDS	Korean Ministry of Food and Drug Safety
CERC	Crisis and Emergency Risk Communication
COVID-19	Coronavirus disease
3T	Testing, Tracing, Treatment

#### **Author contributions**

S.H. is the sole author of this article.

**Funding**

This research was partially supported by the National Research Foundation of Korea (NRF) through a grant funded by the Korean government (MSIT) (No. 2021R1A2C1095688).

**Data availability**

All data generated or analyzed in this study have been included in the published article.

**Declarations****Ethics approval and consent to participate**

Not applicable.

**Consent for publication**

Not applicable.

**Competing interests**

The authors declare no competing interests.

**Author details**

<sup>1</sup>Crisis, Disaster and Risk Management, College of Natural Science, Sungkyunkwan University, Seoul, South Korea

Received: 24 October 2023 / Accepted: 30 July 2024

Published online: 06 August 2024

**References**

- Our World in Data. Daily new confirmed COVID-19 deaths per million people. 2021. <https://ourworldindata.org/covid-deaths>. Accessed 12 July 2023.
- Korean Disease Control and Prevention Agency. COVID-19 vaccination. 2023. <https://ncv.kdca.go.kr/>. Accessed March 23, 2023.
- Our World in Data. COVID-19 vaccine boosters administered per 100. 2022. <https://ourworldindata.org/covid-vaccinations>. Accessed April 2 2023.
- Kim PS. South Korea's fast response to coronavirus disease: implications on public policy and public management theory. *Publ Manag Rev*. 2021;23(12):1736–47.
- Oh J, Lee J-K, Schwarz D, Ratcliffe HL, Markuns JF, Hirschhorn LR. National response to COVID-19 in the Republic of Korea and lessons learned for other countries. *Health Syst Reform*. 2020;6:e–1753464.
- Lee D, Lee J. Testing on the move: South Korea's rapid response to the COVID-19 pandemic. *Transp Res Interdiscip Perspect*. 2020;5(5):10011.
- Lee S. Steering the private sector in COVID-19 diagnostic test kit development in South Korea. *Front Public Health*. 2020;8:563525.
- Asian Development Bank. The Republic of Korea's coronavirus disease pandemic response and health system preparedness. Manila: Asian Dev Bank, 2021. <https://www.adb.org/sites/default/files/publication/730201/republic-korea-coronavirus-disease-pandemic-response.pdf>
- Asian Development Bank. Assessment of COVID-19 response in the Republic of Korea. Manila: Asian Development Bank; 2021. <https://www.adb.org/sites/default/files/publication/691441/assessment-covid-19-response-republic-korea.pdf>.
- World Health Organization. Director-General's opening remarks at the mission briefing on COVID-19- 9. 2020. <https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-mission-briefing-on-covid-19---9-april-2020> Accessed May 10, 2023.
- Bigdeli M, Rouffy B, Lane BD, Schmets G, Soucat A, Bellagio Group. Health systems governance: the missing links. *BMJ Global Health*. 2020;5(8):e002533.
- Ortenzi F, Marten R, Valentine NB, et al. Whole of government and whole of society approaches: call for further research to improve population health and health equity. *BMJ Glob Health*. 2022;7:e009972.
- Skelcher C, Rathgeb S. Theorizing hybridity: institutional logics, complex organizations, and actor identities: the case of nonprofits. *Public Admin*. 2015;93(2):433–48.
- Aripin S, Rulinawaty R. Hybrid government: mixed and hybrid models of public service delivery in disadvantaged, foremost and outermost regions. *KnE Social Sci*. 2022; 1109–23.
- Yin RK. Case study research: design and methods. 3rd ed. Thousand Oaks, Calif.: Sage; 2003. pp. 1–181.
- Tenbenschel T, Silwal PR. Cultivating health policy capacity through network governance in New Zealand: learning from divergent stories of policy implementation. *Policy Soc*. 2022;42(1):49–63.
- Kapucu N, Hu Q. An old puzzle and unprecedented challenges: coordination in response to the COVID-19 pandemic in the US. *Public Perform Manag Rev*. 2022;45(4):773–98.
- Kickbusch I, David G. Governance for health in the 21st century. Geneva: World Health Organization. regional office for Europe; 2012. pp. 3-128. [https://www.euro.who.int/\\_\\_data/assets/pdf\\_file/0004/171920/RC62BD01-Governance-for-Health-Web.pdf](https://www.euro.who.int/__data/assets/pdf_file/0004/171920/RC62BD01-Governance-for-Health-Web.pdf)
- Kim W, Jung TY, Roth S, Um W, Kim C. Management of the COVID-19 pandemic in the Republic of Korea from the perspective of governance and public-private partnership. *Yonsei Med J*. 2021;62(9):777–91.
- Tao JL. Local discretion and environmental policy making in South Korea: three models and a test. *Korean J Policy Stud*. 2016;31(3):1–26.
- Park M. Infectious disease-related laws: prevention and control measures. *Epidemiol Health*. 2017;39:e2017033–1.
- Im T, Campbell JW. Coordination, incentives, and persuasion: South Korea's comprehensive approach to COVID-19 containment. *J Policy Stud*. 2020;35(3):119–39.
- Korea Legislation Research Institute. Infectious Diseases Control and Prevention Act. 2020. Accessed May 30, 2023.
- Korean Ministry of Education, Operational manual for infectious disease disaster crisis response. 2019. [https://www.jj.ac.kr/\\_custom/jj/\\_common/board/viewer.jsp?attach\\_no=158722](https://www.jj.ac.kr/_custom/jj/_common/board/viewer.jsp?attach_no=158722) Accessed August 10, 2023.
- Korea Centers for Disease Control and Prevention Agency. The plan for prevention and control of infectious diseases (2013~2017). 2013. [https://www.mohw.go.kr/board.es?mid=a10401000000&bid=0008&tag=&act=view&list\\_no=293140](https://www.mohw.go.kr/board.es?mid=a10401000000&bid=0008&tag=&act=view&list_no=293140)
- Korean Ministry of Health and Welfare. The second master plan for prevention and control of infectious diseases (2018–2022). 2018. [http://www.mohw.go.kr/react/jb/sjb030301vwjps?PAR\\_MENU\\_ID=03&MENU\\_ID=&032901&CONT\\_SEQ=345550&page=1](http://www.mohw.go.kr/react/jb/sjb030301vwjps?PAR_MENU_ID=03&MENU_ID=&032901&CONT_SEQ=345550&page=1) Accessed June 3 2023.
- Ryu S-K, Chung S-G. Korea's Early. COVID-19 response: findings and implications. *Int J Environ Res Public Health*. 2021;18(15):8316.
- Korean Ministry of Land, Infrastructure and Transport. MOLIT, MSIT and KCDC launch the COVID 19 data platform. 2020. [http://www.molit.go.kr/english/USR/BORD0201/m\\_28286/DTL.jsp?id=eng](http://www.molit.go.kr/english/USR/BORD0201/m_28286/DTL.jsp?id=eng) Accessed June 4 2023.
- Korea Centers for Disease Control and Prevention Agency. Infectious disease control project guideline. 2020. Seoul, Korea pp. 1-268. <https://library.nih.go.kr/ncmiklib/mlib/mlibViewVolume.do?bibctrlno=8272320> Accessed June 7 2023.
- Jarrom D, Elston L, Washington J, Prettyjohns M, Cann K, Myles, et al. Effectiveness of tests to detect the presence of SARS-CoV-2 virus, and antibodies to SARS-CoV-2, to inform COVID-19 diagnosis: a rapid systematic review. *BMJ Evidence-Based Med*. 2022;27(1):33–45.
- Khandker SS, Nik Hashim NHH, Deris ZZ, Shueb RH, Islam MA. Diagnostic accuracy of rapid antigen test kits for detecting SARS-CoV-2: a systematic review and meta-analysis of 17,171 suspected COVID-19 patients. *J Clin Med*. 2021;10(16):3493.
- Kevadiya BD, Machhi J, Herskovitz J, Oleynikov MD, Blomberg WR, Bajwa N, et al. Diagnostics for SARS-CoV-2 infections. *Nat Mater*. 2021;20(5):593–605.
- Seoul Health Foundation. Seoul City's major COVID-19 response update. [https://www.seoul.go.kr/seoulcom/fileDownload.do?fileName=corona/daily-news-review\\_200409\\_35.pdf](https://www.seoul.go.kr/seoulcom/fileDownload.do?fileName=corona/daily-news-review_200409_35.pdf)
- Yonhap News. Korean-made test kits go big overseas amid new coronavirus pandemic. 2020. <https://en.yna.co.kr/view/AEN20200326006151320> Accessed June 1, 2023.
- Korean Ministry of Health and Welfare. Coronavirus disease-19, the Republic of Korea. 2020. <https://www.mohw.go.kr/kor/Accessed> February 20, 2023.
- The Government of the Republic of Korea. Tackling COVID-19: health, quarantine and economic measures: Korean experience. the Government of Korea. 2020. [https://kosis.kr/files/covid/COVID19\\_5\\_1.pdf](https://kosis.kr/files/covid/COVID19_5_1.pdf)
- Our World in Data. Coronavirus (COVID-19) Testing. 2022. <https://ourworldindata.org/coronavirus-testing> Accessed March 20, 2023.
- Donelle L, Hall J, Hiebert B, Shelley JJ, Smith MJ, Gilliland J, et al. Digital technology and disease surveillance in the COVID-19 pandemic: a scoping review protocol. *BMJ Open*. 2021;11(10):e053962.
- Rowe F. Contact tracing apps and values dilemmas: a privacy paradox in a neo-liberal world. *Int J Inf Manage*. 2020;55:102178.
- Brough AR, Martin KD. Consumer privacy during (and after) the COVID-19 pandemic. *J Publ Pol Market*. 2021;40(1):108–10.

41. Lenca M, Vayena E. On the responsible use of digital data to tackle the COVID-19 pandemic. *Nat Med*. 2020;26(4):463–4.
42. Human Rights Watch. Governments should respect rights in COVID-19 surveillance. 2020. <https://www.hrw.org/news/2020/04/02/governments-should-respect-rights-covid-19-surveillance> Accessed July 25, 2023.
43. Agamben G. *State of exception*. Chicago, IL: University of Chicago; 2005. pp. 1–104.
44. Kim IS. Law in a time of emergency: states of exception and the temptations of 9/11. *U Pa J Const L*. 2004;9:1001–83.
45. World Health Organization. *Global strategy on digital health 2020–2025*. Geneva: WHO. 2021. . <https://www.who.int/publications/i/item/9789240020924> Accessed July 25, 2023.
46. Whitehouse gov. Progress and impact of U.S. government investments in the global health security agenda. 2020. <https://www.whitehouse.gov/wp-content/uploads/2021/10/Global-Health-Security-Agenda-Annual-Report.pdf>
47. Ioannou A, Tussyadiah I. Privacy and surveillance attitudes during health crises: acceptance of surveillance and privacy protection behaviours. *Technol Soc*. 2021;67:101774.
48. Statista [Internet]. South Korea smartphone penetration (share of population) 2015–2025. (2023). <https://www.statista.com/statistics/321408/smartphone-user-penetration-in-south-korea/> Accessed August 10, 2023.
49. Yonhap News. Mobile carriers release QR code entry log on ID app to fight virus's spread. (2020) <https://en.yna.co.kr/view/AEN20200624005900320> Accessed August 15, 2023.
50. Haldane V, De Foo C, Abdalla SM, et al. Health systems resilience in managing the COVID-19 pandemic: lessons from 28 countries. *Nat Med*. 2021;27(6):964–80.
51. Arsenault C, Gage A, Kim MK, Kapoor NR, Akweongo P, Amponsah F, et al. COVID-19 and resilience of healthcare systems in ten countries. *Nat Med*. 2022;28(6):1314–24.
52. Struyf T, Deeks JJ, Dinnes J, Takwoingi Y, Davenport C, Leeflang MM, et al. Signs and symptoms to determine if a patient presenting in primary care or hospital outpatient settings has COVID-19. *Cochrane Database Syst Rev*. 2022;5(5):CD013665.
53. Carpenter CR, Mudd PA, West CP, Wilber E, Wilber ST. Diagnosing COVID-19 in the emergency department: a scoping review of clinical examinations, laboratory tests, imaging accuracy, and biases. *Acad Emerg Med*. 2020;27(8):653–70.
54. Fatima S, Ratnani I, Husain M, Surani S. Radiological findings in patients with COVID-19. *Cureus*. 2020;12(4):e7651.
55. Choi UY, Jung SE, Kim MS, Oh HS, Kwon YM, Lee, et al. Analysis of a COVID-19 prescreening process in an outpatient clinic at a university hospital during the COVID-19 pandemic. *J Korean Med Sci*. 2021;36(42):e295.
56. National Medical Center. Clinical practice guideline for coronavirus disease 2019. (ver 2.0). (2021) <https://www.nmc.or.kr/icd/bbs/B0000070/view.do?nttlid=12596&menuNo=1300032&pageIndex=1> Accessed September 1, 2022.
57. Central Disaster Management Headquarters. Coronavirus disease 19 (COVID-19) <https://ncov.kdca.go.kr/en/bdBoardList.do> Accessed September 1, 2022.
58. Maeil Business News. Telemedicine app Doctor Now enjoys surge in transactions during pandemic. <https://pulse.mk.co.kr/news/english/10041617> Accessed September 2, 2022.
59. Medi:Gate News. The government proposes respiratory specialty clinics... Public Health Centers supported by local doctors. <https://m.medigatenews.com/news/1326098081> Accessed October 1, 2022
60. National Institutes of Health. Coronavirus disease 2019 (COVID-19) treatment guidelines. <https://www.covid19treatmentguidelines.nih.gov/>. Accessed October 7, 2022.
61. Korean Ministry of Health and Welfare. Financial support of KRW 39 billion for 69 COVID-19 designated hospitals. (2020). [http://www.mohw.go.kr/react/al/sal0301vw.jsp?PAR\\_MENU\\_ID=04&ME](http://www.mohw.go.kr/react/al/sal0301vw.jsp?PAR_MENU_ID=04&ME) Accessed October 10, 2022.
62. Baek AR, Choo EJ, Kim JY, Ha TS, Park SW, Shin HB, et al. A transient effect of convalescent plasma therapy in a patient with severe coronavirus disease 2019: a case report. *Infect Chemother*. 2022;54(3):553–58.
63. Hong SA. Six pivotal lessons learned in South Korea for whole-of-government approach to successful COVID-19 vaccine roll out in planetary health. *OMICS J Integr Biol*. 2022;26(10):567–79.
64. Korean Ministry of Health and Welfare. [policy briefing] The government and companies are collaborating to accelerate the development of COVID-19 treatment and vaccines. (2020) [https://www.mohw.go.kr/react/al/sal0301vw.jsp?PAR\\_MENU\\_ID=04&MENU\\_ID=0403&page=199&CONT\\_SEQ=360060](https://www.mohw.go.kr/react/al/sal0301vw.jsp?PAR_MENU_ID=04&MENU_ID=0403&page=199&CONT_SEQ=360060) Accessed March 1, 2023.
65. Yonhap News. Korea approves use of 1st homegrown COVID-19 vaccine from SK Bioscience. (2022). <https://en.yna.co.kr/view/AEN20220629005351320> Accessed March 2, 2023.
66. Korean Culture and Information Service. Korea's vaccine hub ambitions. (2021). <https://www.kocis.go.kr/eng/webzine/202109/sub09.html> Accessed April 15, 2023.
67. Korean Ministry of Interior and Safety, After. COVID-19, the administration asks which way to go. (2020). [https://www.mois.go.kr/frt/bbs/type010/commonSelectBoardArticle.do?bbsId=BBSMSTR\\_000000000008&nttlid=77455](https://www.mois.go.kr/frt/bbs/type010/commonSelectBoardArticle.do?bbsId=BBSMSTR_000000000008&nttlid=77455) Accessed February 20, 2023.
68. Iroun Net News. Vaccination and citizen participation are the key to restoring everyday life after COVID-19. (2021). <https://www.eroun.net/news/articleView.html?idxno=24037> Accessed May 1, 2023.
69. Republic of Korea. [Policy Briefing] COVID-19 metropolitan medical response field meeting. (2021). <https://www.korea.kr/multi/policyPhotoView.do?bbsKey=45046> Accessed May 15, 2023.
70. <https://m.medigatenews.com/news/3181618432> Accessed June 15, 2023.
71. Korea Centers for Disease Control and Prevention Agency. Implementation of COVID-19 infection management allowance. (2022). [https://www.kdca.go.kr/filepath/boardDownload.es?bid=0015&list\\_no=718447&seq=2](https://www.kdca.go.kr/filepath/boardDownload.es?bid=0015&list_no=718447&seq=2) Accessed July 20, 2023.
72. Jeong BG, Kim SJ. The government and civil society collaboration against COVID-19 in South Korea: a single or multiple actor play? *Nonprofit Policy Forum*. 2021;12(1):165–87.
73. Lee TL. Legal preparedness as part of COVID-19 response: the first 100 days in Taiwan. *BMJ Global Health*. 2020;5:e002608.
74. Kim J, Moon J, Jung TY, Kim W, Yoo HC. Why have the Republic of Korea, Taiwan, and Singapore coped well with COVID-19 and what are the lessons learned from their experiences? *Yonsei Med J*. 2022;63(3):296.
75. Muraille E, Naccache P, Pillot J. The tragedy of liberal democratic governance in the face of global threats. *Front Public Health*. 2022;10:902724.
76. Salvati E. Fragmentation and intergovernmental conflict during the COVID-19 crisis: the complex relationship between national and regional governments in Italy. *Reg Fed Stud*. 2022;1–30.
77. Gowd KK, Veerababu D, Reddy VR. COVID-19 and the legislative response in India: the need for a comprehensive health care law. *J Public Aff*. 2021;21(4):e2669.
78. De Foo C, Verma M, Tan SY, Hamer J, van der Mark N, Pholpark A, et al. Health financing policies during the COVID-19 pandemic and implications for universal health care: a case study of 15 countries. *Lancet Glob Health*. 2023;11(12):e1964–77.
79. Warren GW, Lofstedt R. Risk communication and COVID-19 in Europe: lessons for future public health crises. *J Risk Res*. 2022;25(10):1161–75.
80. García RL. Disinformation, misinformation and limits on freedom of expression during the Covid-19 pandemic: a critical inquiry. 2023;(21):e8149.
81. Sauer MA, Truelove S, Gerste AK, Limaye RJ. A failure to communicate? How public messaging has strained the COVID-19 response in the United States. *Health Secur*. Feb; 2021;19(1):65–74.
82. Bipartisan Policy Center. Positioning America's public health system for the next pandemic. 2021. [https://bipartisanpolicy.org/download/?file=/wp-content/uploads/2021/06/Public-Health-Report\\_RV2.pdf](https://bipartisanpolicy.org/download/?file=/wp-content/uploads/2021/06/Public-Health-Report_RV2.pdf)
83. Mellish TI, Luzmore NJ, Shahbaz AA. Why were the UK and USA unprepared for the COVID-19 pandemic? The systemic weaknesses of neoliberalism: a comparison between the UK, USA, Germany, and South Korea. *J Glob Faultlines*. 2020;7(1):9–45.
84. GOV.UK. COVID-19 Response: Living with COVID-19. (2022). <https://www.gov.uk/government/publications/covid-19-response-living-with-covid-19/covid-19-response-living-with-covid-19> Accessed March 1, 2024.
85. House of Commons. Government preparedness for the COVID-19 pandemic: lessons for government on risk. (2022) <https://www.parliament.uk/site-information/copyright-parliament/>. Accessed January 1, 2024.
86. Dixit S, Ogundeji YK, Onwujekwe O, Ezenwanfor C, Ohiri K, Ogbuoji O et al. Nigeria's policy response to COVID-19. Policy Report. The Center for Policy Impact in Global Health: 2020. <http://centerforpolicyimpact.org/our-work/the-4ds/nigeria-policy-response-to-covid-19/> Accessed March 2, 2024.
87. Kim S, Goh Y, Kang JHB. Moving toward a common goal via cross-sector collaboration: lessons learned from SARS to COVID-19 in Singapore. *Glob Health*. 2022;18(1):82.
88. Park H, Sim B, Zhao B, Nam EW. Public health financing and responses to COVID-19: lessons from South Korea. *Healthcare*. 2022;10(4):750.

89. Hong SA. COVID-19 vaccine communication and advocacy strategy: a social marketing campaign for increasing COVID-19 vaccine uptake in South Korea. *Humanit Soc Sci Commun.* 2023;10(1):109.

### **Publisher's Note**

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.