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COVID-19 vaccination program in South Korea: A long journey toward a new normal

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ABSTRACT

Objectives: This article presents an overview of South Korea's COVID-19 vaccination program and describes the key measures the country enacted to overcome the initial vaccine shortage and expand the vaccinated population.

Methods: Review of official government documents, international and local databases, and media reports regarding the COVID-19 vaccination program.

Results: South Korea overcame the early phase of vaccine shortage and quickly expanded vaccination coverage by evidence-based priority setting and transparent information sharing using innovative technologies.

Conclusions: It was important to secure effective and safe vaccines as early as possible to fight against COVID-19, yet the delayed start did not equate to failure. Persistent innovation and rapid adaptation to changing circumstances allowed South Korea to expand its vaccination coverage despite the initial delay in procuring vaccine doses. However, the emergence of virus variants and the waning effect of the vaccines require that Korea initiate a new vaccination program that includes booster shots.

Public Interest Summary: Vaccination is a safe and effective way to fight against COVID-19. However, acquiring adequate vaccine supply and administering doses safely and effectively are difficult tasks. South Korea accomplished this mission initially using innovative technologies and rapidly adapting to changing circumstances. However, new variants and decreasing vaccine efficacy induce the Korean government to begin another vaccination program that includes booster shots.

Introduction

The COVID-19 pandemic has lasted almost two years; throughout this time, the virus has varied and evolved, demanding that the whole world make prompt yet conscientious decisions. Because of the continued changes surrounding COVID-19, it is difficult to assess which countries have exhibited an effective response to this global health crisis. However, South Korea, once the second-most affected country after China in early 2020, came to show an effectual response with innovative practices, such as drive-thru and walk-thru testing, epidemiological information systems, and residential treatment centers deployed as part of test, trace, and isolate process. The country also benefited from its previous experience with the Middle East Respiratory Syndrome epidemic and from its pre-existing universal health care system. Dedicated medical professionals and public participation through active wearing of face masks and maintaining social distance

were the most valuable contributors to overcoming the pandemic [1,2].

The COVID-19 vaccines were developed earlier than expected, by the end of 2020, and with this prompt development, the war against the disease, which had mainly been handled with non-pharmaceutical interventions, entered a new phase. When the COVID-19 vaccines were more available, several Asian countries such as South Korea, Vietnam, and Taiwan did not make bold attempts to secure proper vaccine volume as early as possible; these countries were confident in their ability to suppress the spread of the virus non-medically and reluctant to take the risk of implementing vaccines.[3] Korean citizens harshly criticized this decision and formed less than positive views of the government.

Because of those delays in procuring sufficient vaccine doses, Korea had not yet started its vaccination program by the beginning of 2021, placing it behind countries that had initiated more prompt responses such as the United Kingdom (8 December 2020), the United States (December 14), and Israel (December 19) [23]. Therefore, by early

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2021, Korea faced a vaccine shortage that placed it further behind in its goal to initiate a vaccination program; the first priority group had to be very limited because of the shortage.

Facing political and societal pressure, South Korea announced a COVID-19 vaccination plan in January 2021, setting an initial target of 70% of the population fully vaccinated by November 2021; the program was finally initiated on 26 February 2021. As Fig. 1 shows, however, South Korea, even with its late start, overcame the early vaccine shortage and not only achieved but exceeded its target: Korea had fully vaccinated 80% of the population by the end of November 2021 [4,23]. Therefore, Korea’s experience can be a useful lesson for other countries preparing to initiate a COVID-19 vaccination program.

In this article, Korea’s vaccination program will be articulated with regard to governance, procurement, administration, and priority setting as well as managing adverse reactions. This article reviews the progress of the government’s vaccination and the evolving changes in the disease trends and fatality rates in an increasingly vaccinated population. This article also examines the socioeconomic influences of the nation’s vaccination performance.

Governance

As the development of effective and safe vaccines became predictable in June 2020, a special task force of experts was formed within the Korea Disease Control and Prevention Agency (KDCA) to monitor international vaccine developments; the government then used the task force’s findings to build a both bilateral and multilateral approach to vaccine procurement. The KDCA was in charge of these contracts and ensured the government funding; however, the vaccine contracts were delayed and had not been drawn up and finalized by the end of 2020. Combined with the limited volume of doses, Korea could not anticipate beginning a program before February 2021, and when the program finally began, the government had to maximize the deployment of its limited vaccine supply. Pressure from the Korean citizenry led to the collaboration of multiple ministries and agencies for a whole-of-government approach involving the Ministries of National Defense;

Land, Infrastructure and Transport; Trade, Industry and Energy; and the Interior and Safety. To overcome the topological limitations of the KDCA, a vice minister-level organization, the president, and the prime minister backed the efforts with full government support. As a result, the KDCA could act as a control tower for the entire vaccination program from the planning to the management (Table 1) [8].

Procurement difficulties

The Korean government purchased vaccines built on a variety of platforms such as virus vectors and mRNA in consideration of uncertainty about the effectiveness and safety of vaccines as well as their collective capacity to allow Korea to achieve herd immunity. Around 194 million doses of vaccine had been contracted as of August 2021, and to continue actively procuring vaccine doses, the Korean government continued to pay attention to and support diplomatic efforts by the KDCA as well as government ministries such as the Ministry of Trade, Industry and Energy. The Office of the President fully supported all these efforts, and with these collective resources, the Korean government was able to procure more than enough vaccines for the entire national population of 51 million (see Table 2) [16].

Although the government was able to contract for enough vaccines to

Table 1
Collaboration by Department on Korea’s Vaccination Program

Role and Responsibility	Department
Vaccination program planning and management	Korea Disease Control and Prevention Agency
Security support for vaccine distribution and storage	Ministry of National Defense
Direct support to local governments to administer the vaccination program	Ministry of the Interior and Safety
Rapid support system for vaccine air transport and customs clearance	Ministry of Land, Infrastructure and Transport, Korea Customs Service
Support in procuring vaccines and syringes	Ministry of Trade, Industry and Energy, Public Procurement Service

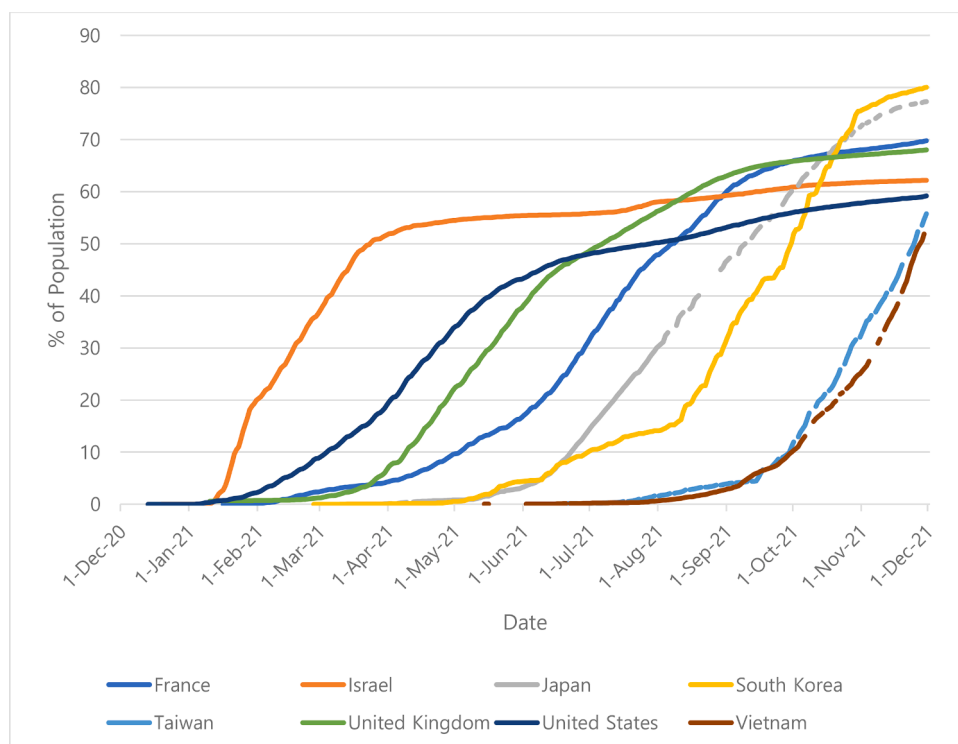


Fig. 1. Rates of Full Vaccination by Country and Month. (note that due to incomplete data reporting several lines are not continuous.)

Table 2
South Korea's 2021 Vaccine Procurement Plan

Manufacturer		Contracted Volume of Vaccines	Vaccine Delivery Timing			
			1 st Quarter	2 nd Quarter	July -August	September - December (expected)
Bilateral Contract	Astra Zeneca	20 million doses	1.6 million doses	7.2 million doses	11.2 million doses	145.4 million doses
	Pfizer/BioNtech	67 million doses	1 million doses	6 million doses	14.1 million doses	
	Moderna	40 million doses		0.1 million doses	3.4 million doses	
	JNJ	7 million doses		1 million doses	0.5 million doses	
	Novavax	40 million doses				
COVAX Facility	Astra Zeneca	20 million doses		1.3 million doses	0.8 million doses	
	Pfizer/BioNtech		0.1 million doses	0.3 million doses	-	
	Total	194 million doses	2.7 million doses	15.9 million doses	30 million doses	

cover the population, in the first quarter, only 2.7 million vaccines were deliverable in Korea because the countries that had contracted earlier received the initial supplies. Some countries, such as Israel, the United States, and the United Kingdom, were able to acquire their vaccine supplies in advance through rigorous, pre-emptive contracts with pharmaceutical companies. The Korean public's consensus opinion was that the KDCA should have full autonomy to proactively negotiate for and procure vaccines. In response, the National Assembly amended the Infectious Disease Prevention and Management Act to bestow legal authority and exemption of indemnity on government officials to procure vaccines under emergency in the event of disasters such as a pandemic [5].

Priority setting

The Korean government set its priority targets based on three objectives, which are as follows: reducing disease severity and mortality, mitigating virus spread, and preventing the collapse of important societal functions. These were objectives that aligned with the World Health Organization guidelines [6]. To achieve these goals, Korea set the target that more than 70% of the population should be fully vaccinated by November 2021, with the goal of achieving herd immunity [7]. Notably today, however, there is doubt that the current vaccines can fulfil this objective against virus mutations such as the delta and omicron variants [22].

To pursue its national COVID-19 objectives, Korea established an advisory group to develop a vaccine prioritization policy. The Korea Advisory Committee on Immunization Practices (KACIP) carefully reviewed relevant studies and different stakeholders' opinions and advised on specific vaccination practices. KACIP, which consists of experts in various fields and representatives of related ministries, is a legal entity under the Infectious Disease Prevention and Management Act. All KACIP's meeting notes and decisions are openly released to the public with detailed rationales for committee decisions.

Through this open procedure, the COVID-19 vaccination program was established and announced in January 2021. As shown in Table 3, group A was identified as people at high risk because of age or underlying diseases, with priority assigned to residents and staff of long-term care facilities based on their vulnerability and the characteristics of co-living. Group B were people who had frequent close contact with people in the highest-risk group; group B priority was for health care professionals who directly treated COVID-19 patients. The final group, C, were people deemed to be at the least risk in terms of mortality and severity. However, some of the people in this group argued that they should have higher priority because they served institutionalized populations in close contact; the shared living aspect of institutions makes it easy for viruses to spread rapidly [8].

With time, however, the vaccination priorities shifted in response to changes in vaccine supply and in epidemiologic conditions. For example, high school seniors had not been included in the initial vaccination plan, but KACIP assessed the increased risk in high schools

Table 3
January 2021 Vaccination Prioritization

	1 st Quarter	2 nd Quarter	3 rd Quarter
Group A	<ul style="list-style-type: none"> Residents and staff of long-term care facilities 	<ul style="list-style-type: none"> Persons > 65 	<ul style="list-style-type: none"> Persons with underlying medical conditions, Persons > 60 Persons > 50
Group B	<ul style="list-style-type: none"> Health care professionals who treat COVID-19 patients Professionals with close contact with risk group (e.g., epidemiologists, emergency department personnel) 	<ul style="list-style-type: none"> Health care professionals 	<ul style="list-style-type: none"> Persons who serve in critical societal functions (e.g., soldiers, police officers)

and also considered the eventual national university entrance exams; in response, this group was designated eligible starting on July 19 [11]. The Korean government also took adverse vaccine events seriously and revised the vaccination target based on reports of these events. In the first quarter of 2021, thrombosis with thrombocytopenia syndrome (TTS) was reported as an adverse reaction to virus vector vaccines such as Astra Zeneca's. In response to this issue, KACIP performed cost-benefit analysis for each age group and revised the plan to authorize virus vector vaccinations only to adults age 30 and older; the data revealed that TTS risk was greater than the vaccine benefits in the younger population [21]. The Korean government publicized all plan revisions in monthly and quarterly public reports, and this transparency increased the public's willingness to get vaccinated with little hesitancy or protest; this public cooperation was infrequent [9].

Reducing physical and financial barriers to vaccination

Vaccine distribution, storage, and administration differ across platforms, and KACIP selected vaccines for each target group based on vaccine distribution around the country and on individual facility capacity. For the mRNA vaccines, which required storage at ultra-low temperature, 250 vaccination centers were installed nationwide at large auditoriums and sports facilities, and medical institution staff and patients were allowed to be vaccinated at their institutions. In addition, mobile vaccination teams visited community welfare centers to expand vaccination to Korea's disabled populations. Once the Korea Food and Drug Authority permitted the mRNA vaccines to be stored at a warmer temperature, vaccination storage capacity expanded to almost 1,500 local clinics.

Korea's COVID-19 vaccination program was fully funded by the central and local governments and was entirely free of charge for all citizens including foreign citizens who had resided in Korea longer than three months. No one irrespective of their vaccine prioritization faced a

financial barrier to getting vaccinated.

Administering the vaccination program through innovative technologies

South Korea is a leading country in information and communication technology (ICT); in its 2017 ICT development index, the International Telecommunication Union ranked Korea second in the world after Iceland [10]. Partly in response to the initially insufficient quantities of vaccine doses across the country, Korea instituted a nationwide reservation system to efficiently distribute the vaccines to all who were eligible including foreigners. The country’s advanced stage of technological development was favorable for creating and managing such a system.

Korea rotated reservation by age group to minimize burden on the data server and maintain system stability. Because of earlier difficulties that had been observed during attempts to have elderly citizens make reservations at the National Immunization Program, Korea not only built the online reservation system but also established designated call centers to assist people with making reservations if they had trouble online. At the end of May 2021, an innovative system was made available to allow real-time last-minute digital reservations toward the end of every day to both expand coverage and reduce vaccine waste. Waste was otherwise inevitable because it was generally conventional that every facility opened around five to ten doses daily, and once doses are opened, they have to be administered the same day or discarded. This daily last-minute-reservation system was developed through public-private cooperation with Korean IT companies to reduce vaccine disposal and benefit more people. The service also achieved a spill over effect of encouraging non-vaccinated people to seek vaccination because they could make unplanned, last-minute appointments (Fig. 2) [24].

It is difficult to prove a direct correlation between the real-time reservation system and the public’s behavior changes. However, according to an opinion poll co-hosted by the Korea Broadcasting System and the Seoul National University Graduate School of Health, the percentage of people who wanted a vaccination increased by 16.3% points from May to June, from 59.2% in May to 75.5% in June [11]. This more than 15% points change within a month suggests that the last-minute vaccination reservation system might have influenced people behaviors.

In addition, a specially manufactured low dead space (LDS) syringe was also introduced to minimize the waste of residual vaccines, which allowed for administering 15% more doses from one vial (Table 4) [11]. These two innovations, in technical and allocation efficiency, maximized Korea’s limited vaccine supply.

Table 4
Vaccine Savings with the LDS Syringe

Manufacturer	Saving Doses (ratio)
Astra Zeneca	1.37 million doses (15.6%)
Pfizer/BioNtech	670,000 doses (14.6%)
JNJ	100,000 doses (11.2%)
Total	2.15 million doses (15.0%)

Managing adverse events with transparency

Because of both safety concerns and a need to increase the public’s participation, the Korean government has closely monitored safety issues and regularly disclosed all adverse reaction reports. Additionally, any patients who experienced severe adverse effects (death, anaphylaxis, admission to an inpatient, or intensive care unit, etc.) after vaccination received comprehensive support. To avoid the challenges and complications with the National Immunization Program procedures, such as for seasonal influenza vaccinations, the government greatly simplified the process of seeking compensation for small claims of less than 300,000 Korean won (around US\$250) for adverse effects from the COVID-19 vaccine: The KDCA backed by federal funds fully covered treatment and other expenses for patients who experienced severe adverse reactions [13]. With these proactive government efforts, public anxiety around vaccines steadily decreased, and the rates of adverse reactions reported decreased steadily as vaccinations increased: from 1.84% in February 2021 to 0.52% in August [14].

Changes after vaccination

Vaccination is the most cost effective and practical option for suppressing the spread of a virus [15]. Since the beginning of the vaccination program in Korea in February 2021, the case fatality rate (CFR) has decreased gradually, from 1.79% to 0.89% as of September 2021. This decline of nearly half was achieved by prioritizing adults aged 60 or older, but the age trends for more recent confirmed cases have changed dramatically: As Fig. 3 shows, adults under 60 account for the most COVID-19 cases in Korea [16]. Table 5 shows that more than 80% of the adults 60 and over were fully vaccinated, so that the virus was mainly spreading among the unvaccinated [17]. This pattern shows clearly that it is necessary to complete full or near full vaccination as soon as possible.

Despite these positive findings, however, as Fig. 4 shows, at the same time the percentage of the population that was fully vaccinated increasing, the CFR was plateaued at 0.8 after September 2021 [23]. Indeed, Fig. 5 shows that the infection incidence has been increasing despite the high national vaccination coverage [23].

Vaccination incentives

As the vaccinated population increased, Korea announced a plan to incentivize people to get vaccinated by easing social distancing regulations on the vaccinated population in ways that corresponded to the government’s vaccination goals and focused on social and family gatherings. For example, under the intended plan, the fully vaccinated would be exempt from the ban on gatherings of more than four people at a table in a bar or restaurant and from mandatory masks outdoors. In addition, the vaccinated were planned to be exempt from the obligatory self-quarantine for two weeks on return from travel abroad.

However, these plans were postponed at the end of June 2021 after a new surge of infection. In November 2021, the incentive plan was reintroduced when more than 70% of the population had been fully vaccinated; most social distancing guidelines were also relaxed. However, facilities, such as restaurants and public pools, where it is difficult to wear masks were required to ask visitors to show either proof of vaccination or negative COVID-19 test results.

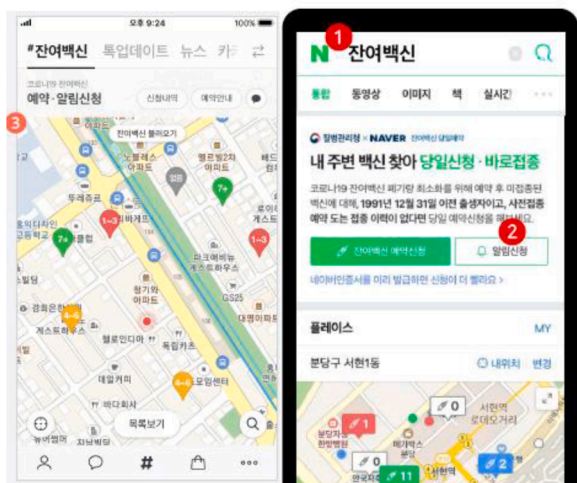


Fig. 2. Real-time vaccination reservation screens.

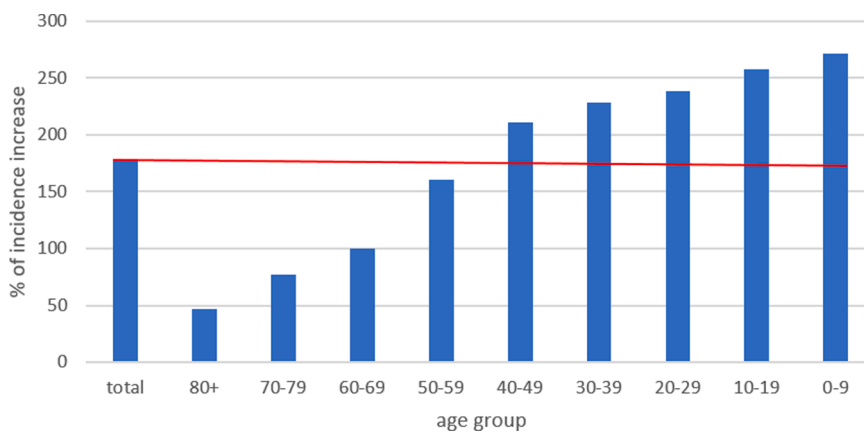


Fig. 3. COVID-19 incidence increases by age group: February – August 2021.

Table 5

Percentage of Fully Vaccinated Population by Age Group: September 2021

age	80+	70-79	60-69	50-59	40-49	30-39	18-29	12-17	<11
%	79.2	88.9	86.4	32.8	24.8	30.1	25.1	0.2	0

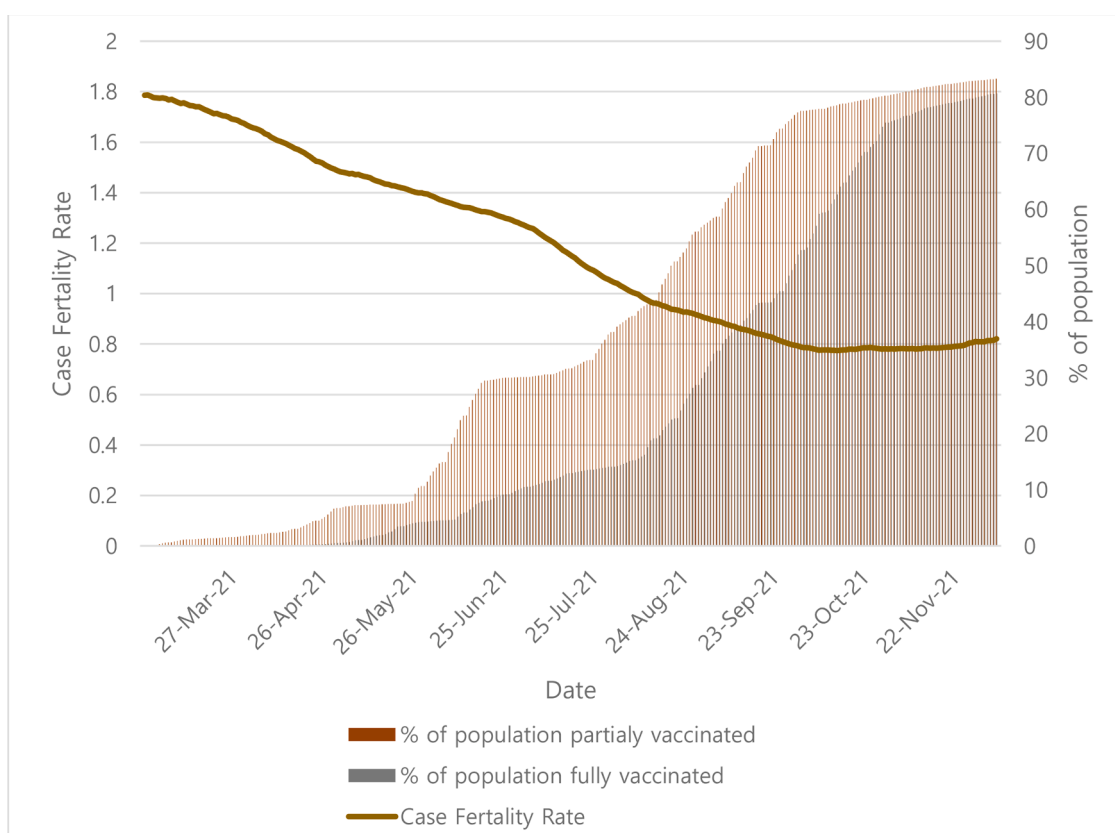


Fig. 4. COVID-19 CFRs and Vaccination Rate in Korea

Socioeconomic disruption

The Organization for Economic Cooperation and Development (OECD) published an interim economic outlook in which South Korea’s gross domestic product had decreased 0.9% in 2020, considerably lower than the OECD member nation average decline of 3.4% for the same year [18]. Indeed, despite the COVID-19 crisis, Korea has maintained the most stable economy of the OECD countries, demonstrating that

infection control was possible without drastic economic destruction. However, in November 2021, a new COVID-19 wave emerged in Korea that required reintroducing the social distancing measures, and this has resulted in social and economic disruption. The most vulnerable, small business owners and untrained workers, are suffering from the length of the business restrictions, which is all the more reason that it is necessary to rapidly increase vaccination rates and enact generous social support policies [19].



Fig. 5. Daily new confirmed COVID-19 cases per million population.(7-day rolling average)

Conclusion

Vaccines were supposed to be a game changer in the battle against COVID-19. However, emerging virus variants and suboptimal vaccine efficacy and supply have stalled the recovery from the pandemic. Countries are facing the challenge of establishing new daily routines supported by community herd immunity. It is possible to achieve this goal in Korea and elsewhere through comprehensive whole-of-government efforts that include but are not limited to the following: ensuring reliable vaccine supply and storage; prioritizing efficient administration; being transparent with the public about adverse reactions and mitigation efforts; and providing economic support where needed such as when patients experience adverse vaccine reactions or when conditions require drastic social distancing measures. As this article described, Korea dedicated the country's entire national competency to accomplishing this mission, but there is still much progress to achieve before life can return to so-called normal. The Korean government needs to review the current vaccination program to ensure that it is still being guided by evidence-based research including on new variants and vaccine boosters. As of 7 December 2021, only 6.2% of the populations of low-income countries had received at least one dose [20], and emerging variants are aggressively demonstrating the importance of global vaccination coverage. The authors of this study hope that this article will be useful for framing plans for low-income countries to expand their capacity to procure and efficiently allocate their vaccine resources.

Patient consent

Not required.

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Competing interests

None.

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