



# Why Have the Republic of Korea, Taiwan, and Singapore Coped Well with COVID-19 and What Are the Lessons Learned from Their Experiences?

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This study investigated how three Asian countries—Republic of Korea (ROK), Republic of China (Taiwan), and Singapore—considered as standouts, responded to the coronavirus disease 2019 (COVID-19) in terms of governance system, health sector innovation, and social distancing to draw lessons that other countries can learn from. The countries were commonly in success of the response in early stage of the pandemic thanks to their effective and efficient strategies paired with advanced information and communications technology (ICT). Consequently, the three jurisdictions reported lower confirmed cases as well as fatality rate of the infectious disease compared to other high-income countries. In addition, the countries' previous experiences with other pandemics, including influenza A, Middle East respiratory syndrome, and severe acute respiratory syndrome, enabled them to establish resilient public health systems and gain public acceptance to governmental control or surveillance during national infectious disease-related crises outbreaks. Advanced ICT infrastructure and digital technology were used as effective tools for testing, tracing, and treatment of the pandemic in collaboration with the private sector as a crucial player. The ROK, Taiwan, and Singapore adopted different strategies between containment and mitigation policy to flatten the epidemic curves effectively according to their own situation and judgement. Despite the exemplary aspect of the three nations in coping with the COVID-19 pandemic, a few limitations were also observed in terms of vaccination and unequal consequences of the pandemic among people. These should be further discussed in order to be prepared for future pandemics.

**Key Words:** COVID-19, Republic of Korea, Taiwan, Singapore, information technology, comparative study

After the coronavirus disease 2019 (COVID-19) struck the world, the pandemic triggered an unprecedented crisis in our lives with a risk of uncertainty involved in all areas. The dreadful COVID-19 pandemic took millions of lives globally. Countries have been striving to cope with this crisis effectively and efficiently

with various public health interventions, such as border control, lockdowns, quarantining, social distancing, as well as developing and distributing vaccines with different degrees of efficacy.<sup>1</sup> However, the consequences of these efforts vary from country to country and region to region. At present, looking back into the past year and preparing for the coming year is worthwhile by investigating how neighbors and frontline countries dealt with the global crisis.<sup>2</sup>

The Republic of Korea (ROK), Republic of China (Taiwan), and Singapore are regarded as standouts, especially in the early stage of the pandemic due to their effective and efficient strategies paired with advanced information and communications technology (ICT) in responding to COVID-19.<sup>2</sup> Up until November 2021, the total number of confirmed COVID-19 cases and deaths per million people have been low among the three aforementioned Asian countries compared to higher-income jurisdictions (Fig. 1).<sup>3,4</sup> Although the recent unexpected rise in confirmed

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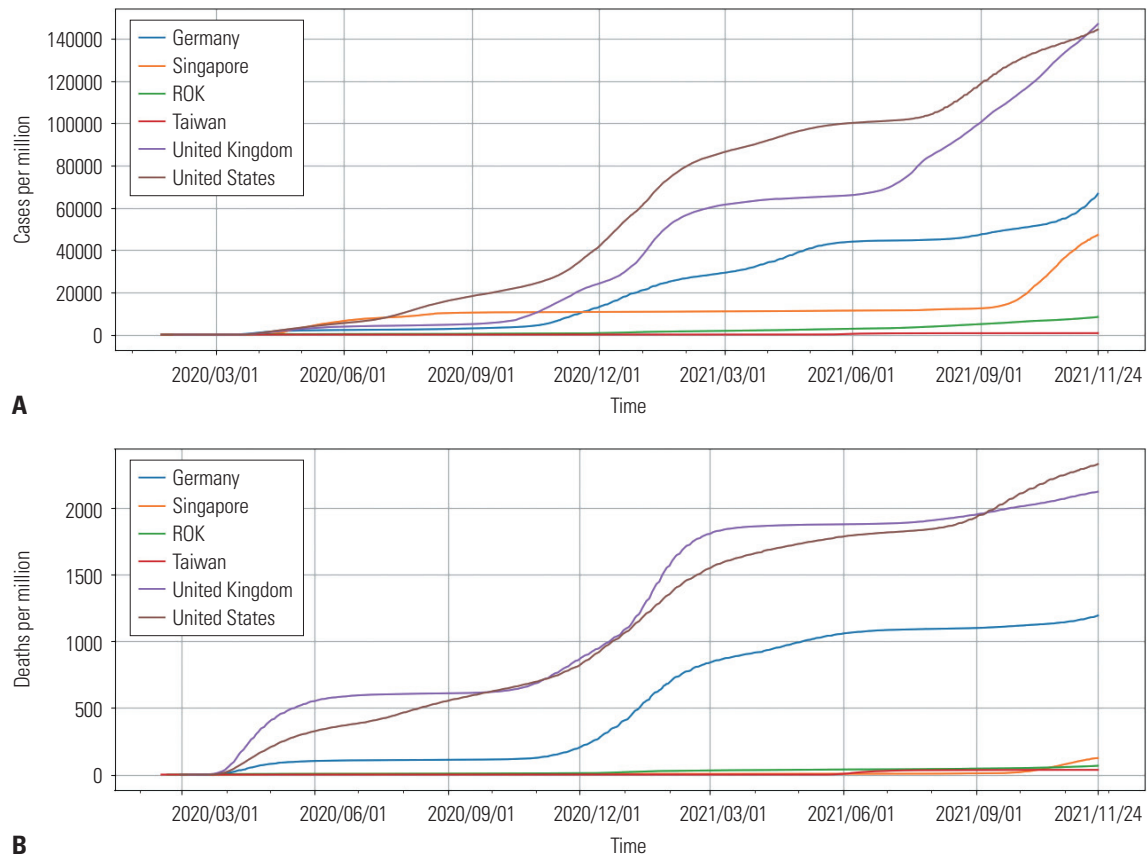
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**Fig. 1.** (A) Total number of confirmed COVID-19 cases per million people by country. (B) Total number of confirmed COVID-19 deaths per million people by country.

cases due to the Delta variant both in Taiwan and Singapore—where nearly zero and single-digit COVID-19 cases were reported since the beginning of 2021—has placed the nations in jeopardy, the accumulated numbers still seem small in comparison to global standards.<sup>5</sup>

We investigated the three nations' responses to COVID-19 considering their governance system, health sector innovation, and social distancing to assess the common factors that lead the countries to their relative successes in coping with the pandemic in early stage (Table 1). Furthermore, we addressed the drawbacks found in each country's COVID-19 response, so that lessons can be learned and taken into account in future actions. The countries' experiences and remarkable progress during the COVID-19 pandemic situation can be drawn into useful strategies that other countries can adopt for future pandemics. The study used information and data provided by national and international organizations (Supplementary Material, only online).

Table 2 details the key epidemiological features of the COVID-19 response, socio-economic conditions, and general medical infrastructure situation in the three countries. All three nations share similar characteristics in many aspects of tackling the COVID-19 situation, and the study focuses on these distinguishing features. Fig. 2<sup>3,4,6</sup> shows the key trends of the COVID-19 situation (cases confirmed, fatality rate, and vaccination) in the three countries. In terms of daily confirmed cases per million

people, Taiwan had maintained a remarkably low number of cases since the outbreak of the pandemic until the Delta variant stroke the island in mid-May 2021. However, Taiwan successfully managed to reduce the daily confirmed cases from 597 on May 28 to a low of 30 cases on July 12, 2021.<sup>3</sup> As shown in Fig. 2, Singapore had a notably low fatality rate at 0.26% compared to other two countries. This was because about 95% of the COVID-19 infections on the island were confirmed in young migrant workers living in cramped dormitories.<sup>7</sup> For the vaccine drive, all three countries were not doing particularly well at the initial stage of the pandemic. The countries had limited vaccine supplies, unlike countries like the US, UK, and China that have the capability to produce their own vaccines.<sup>5</sup> While Singapore achieved a full vaccination rate of 60% by July 2021, ROK only reached to the same stage in October, and Taiwan is still struggling to provide vaccines to its citizens. According to Our World in Data, the percentage of the population who are fully vaccinated was 79.11% in the ROK, 48% in Taiwan, and 91.91% in Singapore, as of November 22, 2021 (for Singapore, November 5, 2021).<sup>6</sup>

There are a few major factors that led the ROK, Taiwan, and Singapore to cope well during the COVID-19 pandemic. First, the three countries have commonly experienced pandemics in the past. The ROK had Influenza A (H1N1) in 2009 and 2010, and the Middle East Respiratory Syndrome (MERS) in 2015.<sup>8</sup>

**Table 1.** Comparison of Governance, Health, and Social Sectors in the Republic of Korea, Taiwan, and Singapore

	Governance	Health	Social
Republic of Korea	<ul style="list-style-type: none"> <li>• Institutional arrangement                             <ul style="list-style-type: none"> <li>- (+) Regional quarantine task force: Korea Disease Control and Prevention Agency (KDCA), Central Disaster and Safety Countermeasure Headquarters (CGSCHO)</li> <li>- (+) Strong regional response capability (Local Disaster and Safety Countermeasure Headquarters)</li> </ul> </li> <li>• Previous experience [Middle East respiratory syndrome (MERS)]                             <ul style="list-style-type: none"> <li>- (+) In favor of mask wearing</li> <li>- (+) Legal foundation for accessing to private information (act on prevention of Infectious diseases)</li> </ul> </li> <li>• Transparent                             <ul style="list-style-type: none"> <li>- (+) Daily briefing on infected cases, facility rate, and paths of infected people before quarantine by government</li> <li>- (+) Cell Broadcasting Service (CBS) for real-time emergency disaster information in Korean, English, and Chinese</li> </ul> </li> <li>• Mitigation strategy                             <ul style="list-style-type: none"> <li>- Less strict border control (allowed inbound travelers in if follow mandatory COVID-19 testing, 2-week self-quarantine, and installing Self-Quarantine Safety Protection app)</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Testing                             <ul style="list-style-type: none"> <li>- (+) Screening center to detect suspected patients at the early stage</li> <li>- (+) Drug utilization review (DUR)/International Traveler Information System (ITS)</li> <li>- (+) Agile engagement of private sector and rapid approval of the authority on diagnostic kits</li> <li>- (+) Rapid and precise massive test (RT-PCR and antibodies)</li> </ul> </li> <li>• Tracing                             <ul style="list-style-type: none"> <li>- (+) Smart Management System (SMS): real-time tracing of routes of confirmed cases</li> <li>- (+) Korea Internet Pass (KI-pass): entrance registration and tracing through mobile phone</li> <li>- (+) Self-quarantine Safety Protection App: Monitoring 4-day quarantine for travelers</li> <li>- Tracing app developed by citizens</li> </ul> </li> <li>• Treatment                             <ul style="list-style-type: none"> <li>- (+) Separation of patients from other patients at the designated national safe hospitals</li> <li>- (+) Caring for mild patients (medical care, living support, and quarantine) at life treatment centers. Transfer of patients to hospital if worsened</li> <li>- (+) Increase in personal protective equipment (PPE) and distribution of medical supplies to medical institutions based on National Health Interview Survey (NHIS) platform in real-time</li> </ul> </li> <li>• Risk communication                             <ul style="list-style-type: none"> <li>- Real-time disclosure of information using open application program interface (API) service</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Citizens' participation for social distancing                             <ul style="list-style-type: none"> <li>- (+) Online religious activities: drive-in worship service supported by Ministry of Science and ICT (MSICT)</li> <li>- (+) Mask wearing</li> <li>- (-) Uncooperative religious leaders</li> <li>- (+/-) Trust in leadership</li> </ul> </li> <li>• Mask provision                             <ul style="list-style-type: none"> <li>- (-) Shortage of face masks during the early stage of the pandemic</li> <li>- (+) 5-day rotation mask distribution system at the early stage (mask rationing)</li> <li>- (+) Publicly available information on the sale of masks</li> <li>- (+) Public procurement service (PPS)</li> </ul> </li> <li>• Distance learning                             <ul style="list-style-type: none"> <li>- (+/-) Schools open under rotation based on existing guidelines</li> <li>- (+/-) Learning management system (LMS) for providing education materials and enabling communication between students and teachers</li> <li>- (+) Capacity building of teachers unfamiliar with the new system</li> </ul> </li> <li>• Base condition                             <ul style="list-style-type: none"> <li>- (-) High population density</li> <li>- (-) Vast territory</li> <li>- (+) No complete lockdown</li> </ul> </li> </ul>
Taiwan	<ul style="list-style-type: none"> <li>• Institutional arrangement                             <ul style="list-style-type: none"> <li>- (+) Strong leadership with medical expertise (high-level decision making)</li> <li>- (+) Local follow-up on detecting &amp; monitoring</li> <li>- (+) Central Epidemic Command Centre (CECC)</li> </ul> </li> <li>• Previous experience [severe acute respiratory syndrome (SARS)]                             <ul style="list-style-type: none"> <li>- (+) In favor of wearing masks</li> <li>- (+) Legal foundation for accessing private information (Taiwanese Infectious disease control act 2007)</li> </ul> </li> <li>• Transparent                             <ul style="list-style-type: none"> <li>- (+) Daily press conferences and press release</li> <li>- 1922 communicable disease reporting and consultation hotline</li> <li>- (+) Bilingual chatbot: Taiwan Centers for Disease Control (TCDC) provides latest information to the public, including foreigners, using social media (ex. Line, Facebook) to share the relevant data and survey results</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Testing                             <ul style="list-style-type: none"> <li>- (-) Decision not to perform mass testing of incoming travelers</li> <li>- (-) Limited testing using RT-PCR and antibodies</li> <li>- (+) COVID-19 testing stations established to respond to the recent spike in virus cases (May 2021)</li> </ul> </li> <li>• Tracing                             <ul style="list-style-type: none"> <li>- (+) Contact tracing based on National Health Insurance (NHI) data on histories from customs &amp; immigration database, cluster control</li> <li>- (+) TRACE: centralized contact tracing system efficiently manages information in real-time with limited number of health workers</li> </ul> </li> <li>• Treatment                             <ul style="list-style-type: none"> <li>- (+) Extensive infectious disease network (selected hospitals, health systems, private clinics, and local health department)</li> <li>- (+) PPE reserve up to 2 months for medical staffs</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Citizens' support for social distancing                             <ul style="list-style-type: none"> <li>- (+) Citizens' appreciation for healthcare workers</li> <li>- (+) Mask wearing (cultural issue)                                     <ul style="list-style-type: none"> <li>- (+) Dialogue between government and religious leaders for cooperation (holding back religious events)</li> </ul> </li> <li>- (+) Trust in leadership</li> </ul> </li> <li>• Mask provision                             <ul style="list-style-type: none"> <li>- (+/-) Ban on mask export</li> <li>- (+) Mask distribution: V.2.0 eMask website or the NHI app from a mobile phone, V.3.0 mobile payment allowed for preorder and purchase</li> <li>- Name-based rationing system 1.0, 2.0, 3.0 for mask distribution</li> </ul> </li> <li>• Distance learning                             <ul style="list-style-type: none"> <li>- (+) Regular face-to-face classes except for universities</li> <li>- CECC guidelines for social distancing: wearing masks, screening travel record, social distancing, 14-day closing upon confirmed cases</li> </ul> </li> </ul>

**Table 1.** Comparison of Governance, Health, and Social Sectors in the Republic of Korea, Taiwan, and Singapore (continued)

	Governance	Health	Social
	<ul style="list-style-type: none"> <li>• Containment policy                             <ul style="list-style-type: none"> <li>- (+/-) Border control (exclusion, screening, quarantine/isolation)</li> <li>- (+/-) Ban on mask export</li> <li>- (+) High-tech surveillance system</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Risk communication                             <ul style="list-style-type: none"> <li>- NHI covers more than 99% of population and support risk identification</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>- Can be adopted by the school's decision: tools and training for online learning provided to school faculty by ministry of education (MOE)</li> <li>- MOE's support to education institutions by requesting each institution to create a taskforce team</li> <li>- Digital Teaching Assistants provided</li> <li>- Synchronous and Asynchronous online courses</li> <li>• Other factors                             <ul style="list-style-type: none"> <li>- (-) Timing of instituting travel advisory</li> <li>- (-) High population density</li> <li>- (-) Proximity to China (130 km)</li> <li>- (+) No local or national lockdown</li> <li>- (-) Allow diamond princess passengers</li> <li>- (+) Reserve medical supplies and PPE from 30–60 days for workers' safety</li> <li>- (+) Governmental compensation for COVID-19 prevention workers (infection: US\$ 12000; death: US\$ 330000)</li> </ul> </li> </ul>
Singapore	<ul style="list-style-type: none"> <li>• Institutional arrangement                             <ul style="list-style-type: none"> <li>- Multi-ministry taskforce by Health Minister and National Development Minister</li> <li>- (+) National Centre for Infectious Diseases (NCID)</li> </ul> </li> <li>• Previous experience (SARS)                             <ul style="list-style-type: none"> <li>- Legal foundation for accessing to private information [COVID-19 (Temporary Measures) (Amendment) Bill, 2021]</li> </ul> </li> <li>• Transparent                             <ul style="list-style-type: none"> <li>- (+) Rapid and transparent governmental response</li> <li>- (+) Accurate and factual information sharing with the public: leadership of Prime Minister using Facebook and Instagram</li> <li>- WhatsApp by Ministry of Health (MOH)</li> </ul> </li> <li>• Containment policy                             <ul style="list-style-type: none"> <li>- (+/-) Border control</li> <li>- (+/-) Strong travel restriction to prevent imported cases</li> <li>- (-) Political transition of People's Action Party (PAP)</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Testing                             <ul style="list-style-type: none"> <li>- (+) Large-scale testing during the early stage of the pandemic</li> <li>- (+) Production of test kits</li> <li>- Free testing and treatment</li> </ul> </li> <li>• Tracing                             <ul style="list-style-type: none"> <li>- Contact tracing operation 24/7</li> <li>- TraceTogether programme (TraceTogether App and Token)</li> <li>- Efforts for contact tracing through identifying proximity (using short-distance signals to detect other participants within vicinity)</li> <li>- Mandatory use of SafeEntry contact tracing system for all businesses and services</li> <li>- Digital check-in for visiting hotspots, workplaces</li> <li>- (-) Concerns on civil liberty and privacy</li> </ul> </li> <li>• Treatment                             <ul style="list-style-type: none"> <li>- National stockpiles of PPE, critical medications, and vaccines for up to 6 months</li> <li>- National Centre for Infectious Diseases Singapore: 330-bed purpose-built facility</li> <li>- Health sector capability from experiences of SARS, MERS, and H1N1</li> <li>- (+) Low fatality rate</li> <li>- Comprised of App &amp; Token</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Social distancing                             <ul style="list-style-type: none"> <li>- (+) Civic engagement for distance learning</li> <li>- (-) Migrant dormitories have difficulties for social distancing</li> <li>- (-) Complete lockdown: twice</li> <li>- Strict laws governing social distancing</li> </ul> </li> <li>• Mask                             <ul style="list-style-type: none"> <li>- (-) Shortage of mask in the beginning</li> <li>- (-) Non-mask wearing in the beginning</li> <li>- Mask wearing later became mandatory</li> </ul> </li> <li>• Distance learning:                             <ul style="list-style-type: none"> <li>- (+/-) Home-based learning: due to the recent spike in virus cases, full home-based learning began on May 19, 2021</li> <li>- (+) When on campus, mask wearing, temperature check, and using hand sanitizer required</li> <li>- (+) Personal laptop or tablet to all secondary school students for online learning, and lectures and tutorials at third-level institutions online</li> <li>- (+) Investment plans for teachers and key education staffs to enhance their capacity</li> </ul> </li> </ul>

Both Taiwan and Singapore had severe acute respiratory syndrome (SARS) outbreak in 2003, with thousands of cases and many deaths in both countries.<sup>9,10</sup> Consequently, these experiences paved the way for the nations to establish robust public health systems, including a legal framework for accessing private information with fewer objections regarding breach of privacy, strengthening a dedicated national agency for control and prevention of infectious diseases, and maintaining transpar-

ency in responding to the pandemic. Regarding the ROK, the Korea Disease Control and Prevention Agency (KDCA) is the primary body for infectious disease prevention and control. However, during national infectious disease-related crises, the Central Disaster and Safety Countermeasures Headquarters (CDSCH) is established and operated as an ad hoc disaster control tower with either the Prime Minister or the Minister of Interior and Safety as the head.<sup>11</sup> The Central Epidemic Command

**Table 2.** Comparison of Key COVID-19 Related Statistics in the Republic of Korea, Taiwan, and Singapore

Factors	Indicators	Republic of Korea	Taiwan	Singapore
COVID-19 related data (as of Nov. 25, 2021)	Total cases*	425065	16,544	257510
	Case/mill population*	8281	693	43538
	Total tests*	15804065	8206060	21098774
	Test/mill population*	307887	343681	3567256
	Test positive rate [%, (total case / total test)*100]	2.69%	0.2%	1.22%
	Total deaths*	3363	848	678
	Death/mill population*	66	36	115
	Active cases*	41325	114	17923
	Fatality rate (deaths/confirmed cases×100)*	0.79%	5.13%	0.26%
	Fully vaccinated (%) <sup>†</sup>	79.11 (Nov. 22)	48 (Nov. 22)	91.91 (Nov. 5)
Socio-economic data	Population (2021)*	51330808	23876976	5914566
	Population density (per km <sup>2</sup> , 2020)	516 <sup>‡</sup>	651 <sup>§</sup>	7810 <sup>  </sup>
	Urban population (% , 2020)*	81.8	78.90	100
	GDP (US\$, 2020) <sup>¶</sup>	1630.9 billion	668.5 billion	339.9 billion
	COVID-19 fiscal measures (US\$)	239 billion**	54.8 billion <sup>††</sup>	70.4 billion**
Medical infrastructure	Hospital beds (per 1000 pp)	12.43 (2018) <sup>‡‡</sup>	7.102 (2018) <sup>§§</sup>	2.49 (2017) <sup>   </sup>
	Physicians (per 1000 pp) <sup>§§</sup>	2.39 (2018)	2.06 (2019)	2.5 (2019)

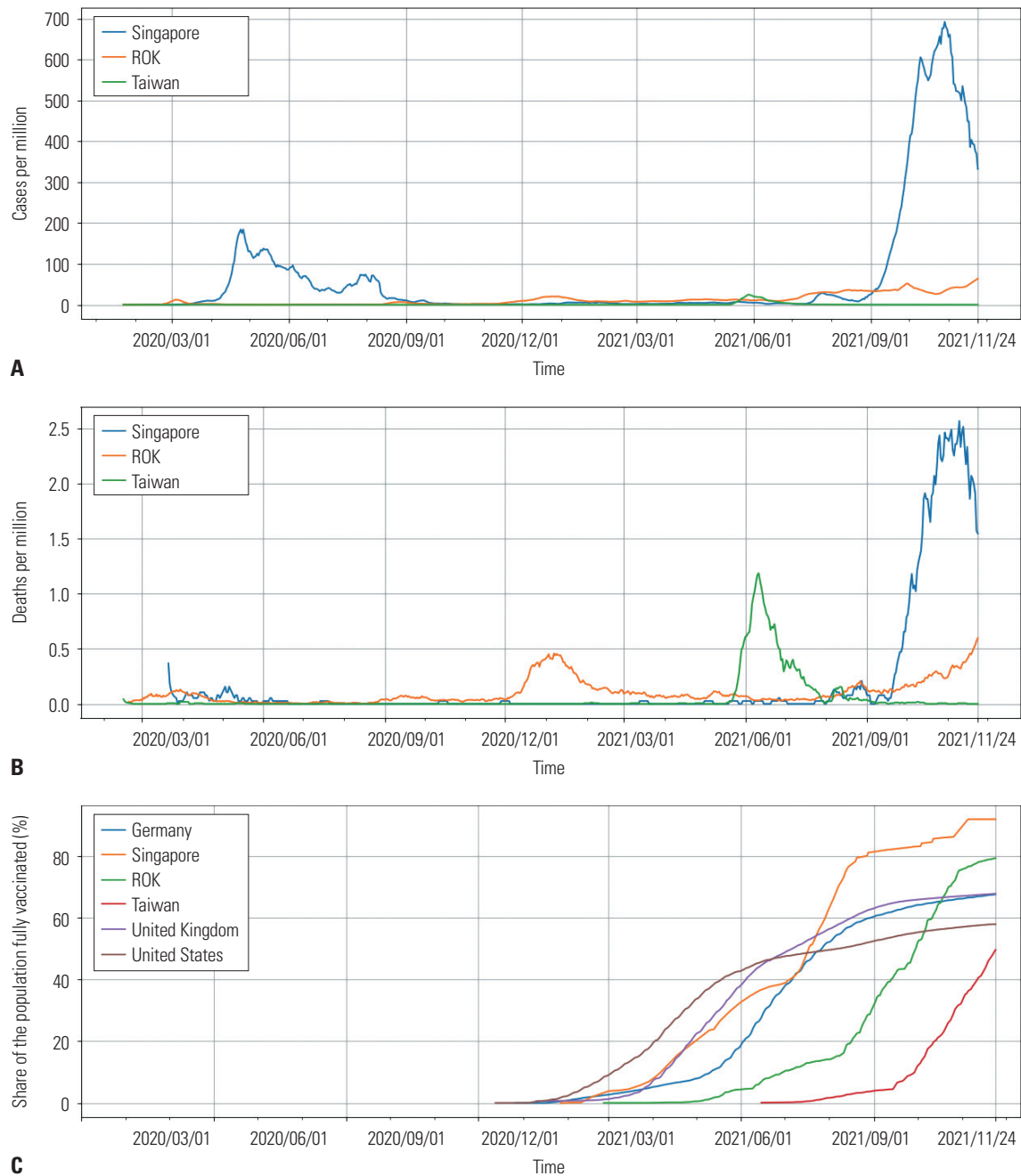
\*Worldometer: Coronavirus and Population Update (Live) (November 25, 2021), <http://www.worldometers.info>, <sup>†</sup>Our World in Data (November 25, 2021), <https://ourworldindata.org/covid-cases?country=>, <sup>‡</sup>E-nara Index Korea (May 16, 2021), [https://www.index.go.kr/potal/main/EachDtlPageDetail.do?idx\\_cd=1007](https://www.index.go.kr/potal/main/EachDtlPageDetail.do?idx_cd=1007), <sup>§</sup>National Statistics, Republic of China (Taiwan) (May 16, 2021), <https://eng.stat.gov.tw/point.asp?index=9>, <sup>||</sup>Department of statistics Singapore (May 16, 2021), <https://www.singstat.gov.sg/find-data/search-by-theme/population/population-and-population-structure/latest-data>, <sup>¶</sup>World Economic Outlook, April 2021. IMF, <https://www.imf.org/external/datamapper/NGDPD@WEO/OEMDC/ADVEC/WEO/WORLD/TWN>, <sup>\*\*</sup>Summary of Country Fiscal Measures in Response to the COVID-19 Pandemic Since January 2020 (Above the line measures and liquidity support) (2021). International Monetary Fund, <https://www.imf.org/en/Topics/imf-and-covid19/Fiscal-Policies-Database-in-Response-to-COVID-19> (cited April 29, 2021), <sup>††</sup>COVID relief and stimulus for industry (Last Updated: Jan. 29, 2021, cited: May 8, 2021). Executive Yuan, <https://english.ey.gov.tw/News3/9E5540D592A5FECDD09d1d995-fe7f-45b8-89ee-6a42d279a280>, <sup>‡‡</sup>World Bank Open Data (2021). The World Bank, <https://data.worldbank.org> (hospital bed, nurses and midwives, GDP, urban population), <sup>§§</sup>Hospital bed density in Taiwan 2009–2018 (2021). Statista, <https://www.statista.com/statistics/324721/taiwan-hospital-bed-density/> (Taiwan hospital bed, Number of Physicians in Korea, Taiwan, Singapore).

Centre (CECC) in Taiwan played a leading role in responding to the pandemic in conjunction with the Taiwan Centers for Disease Control.<sup>1</sup> In Singapore, the National Centre for Infectious Diseases (NCID) has been instrumental in strengthening the country’s capabilities in infectious disease management and prevention.<sup>12</sup> Therefore, the resilient public health systems and public cooperation in all three countries have helped limit the spread of COVID-19.

Second, the three countries have developed advanced ICT infrastructure and digital technology that can be strategically used for effective disaster response in terms of testing, tracing/tracking, and treatment/management, as seen during the COVID-19 pandemic. The KDCA has developed the COVID-19 Smart Management System—an epidemiological investigation support system—to provide the location of confirmed cases within 10 minutes using big data gathered from the use of credit cards, mobile phone location data, closed-circuit television footage, etc.<sup>13</sup> Taiwan adopted extensive contact tracing based on the travel history of individuals from Customs and Immigration to be linked to their National Health Insurance card.<sup>1</sup> Singapore developed the TraceTogether Programme, whose app and token can identify people who were in proximity to an infected person. This helped prevent the disease from spreading in clusters.<sup>14</sup> Furthermore, digital media was used to assure the pop-

ulation of these countries that their governments were in control of the pandemic situation. In this process, the private industry became a critical player; for instance, in test kit development, creating a tracing app based on application program interface data, meeting the intensive demand for personal protective equipment (PPE) and other medical supplies. Rapid cooperation between the government and private sector enabled the countries to quickly respond to the COVID-19 outbreak.<sup>15</sup>

Third, all three countries share significant components of the 3Ts (Test, Trace, and Treatment) in coping with the pandemic in the health sector. For testing, systemic testing with diagnostic kits that show results in less than 4 hours have been developed and implemented. In the ROK, the KDCA supported and rapidly approved the agile participation of the private sector to develop a real-time polymerase chain reaction (RT-PCR) method, which allowed massive and efficient nationwide virus testing.<sup>16</sup> Additionally, new types of inspection systems, such as drive-throughs or walk-throughs, have been established for large-scale rapid inspections. In Singapore, massive testing was conducted in the early stage of the pandemic, and several COVID-19 test kits, such as the Veredus Laboratories’ VereCoV detection kit, A\*STAR, and TTSH’s Fortitude Kit 2.0, were developed. These kits proved crucial for Singapore to contain the outbreak of the virus at an early stage.<sup>17</sup> While Taiwan initially



**Fig. 2** (A) New daily confirmed COVID-19 cases per million people in Singapore, ROK, and Taiwan. (B) New daily confirmed COVID-19 deaths per million people in Singapore, ROK, and Taiwan. (C) Share of population fully vaccinated against COVID-19 by country.

implemented the testing method of RT-PCR and antibodies on a limited scale, the unprecedented spike of virus cases in May 2021 necessitated the establishment of COVID-19 testing stations all over the island.<sup>18</sup> In terms of treatment, the Ministry of Health and Welfare (MOHW) in the ROK had focused on reshaping the hospital system after facing the MERS outbreak, which was mostly linked to hospitals, in 2015.<sup>19</sup> The National Safe Hospital was designed to separate patients with respiratory diseases from other patients throughout the entire treatment process. Moreover, the ROK increased patient care capacity by designating public facilities as residential treatment

centers that only manage patients with mild COVID-19 symptoms.<sup>20</sup> However, the supply and demand of face masks in the early stage of the pandemic were not smooth in the ROK, which led to the implementation of the mandatory public supply of masks, mask rationing based on a 5-day rotation mask distribution system, and restricted mask exports to overcome the mask shortage.<sup>20</sup> In Taiwan, the extensive infectious disease network for effective treatment of the pandemic, including selected hospitals, health systems, private clinics, and local health departments across the island, coordinated emergency facilities when an emergency response was needed. For the safety of

medical staff working at the frontline, the CECC reserved PPEs for up to 2 months.<sup>18</sup> Taiwan's Ministry of Economic Affairs imposed a ban on exports of face masks on January 24, 2020 in order to assure sufficient domestic availability. Based on the Name-based Rationing System, Taiwan also restricted the number of face masks purchased by each citizen. Similarly, in Singapore, the NCID—a 330-bed purpose-built facility—strengthened Singapore's capabilities in the management and prevention of infectious disease. Moreover, since the experience of SARS in 2003, a national stockpile of PPEs, critical medications, and vaccines were secured in advance for up to 6 months after the virus outbreak.<sup>21</sup> The government recognized the shortage of masks among the general public; therefore, Singapore's leaders originally urged citizens to wear masks only if they were already ill, until the beginning of April 2020. However, Singapore's Ministry of Health recommended that “masks will now be required as the default” from June 2020, due to their effectiveness to prevent the spread of the virus.<sup>22</sup>

Lastly, the citizens of ROK, Taiwan, and Singapore followed the social distancing guidelines issued by their governments, thus lowering the rate of community infections. The three countries share the same cultural roots of Confucianism, which indicates culture as a driver of relatively successful responses to the pandemic in Asian countries compared to the West. Confucianism emphasizes one's duties to family and society over individual rights, which has resulted in public acceptance of a great degree of governmental control or surveillance.<sup>23</sup> For example, mask wearing imposed by authorities and patient tracing based on collected personal information were accepted by the public without strong objection in these three countries.

The three countries' cases provided significant lessons indicating that the containment and mitigation strategies in dealing with COVID-19 have been effective in flattening the epidemic curves. To restore society, the most beneficial and least costly measures should be adopted after reopening borders and economies.<sup>24</sup> The ROK has neither imposed a draconian lock-down nor stringent border control as a response to the pandemic, whereas Singapore opted for the opposite with two circuit breakers and strong border control. Taiwan never had to go into lockdown until the outbreak of the COVID-19 variant in May 2021, but focused on early and strict border controls with a ban on foreign visitors.<sup>5</sup> Whether the virus response involved containment strategy or mitigation policy, what is important is that all three countries succeeded in their initial response to the COVID-19 pandemic.<sup>25</sup>

Despite exemplary aspects of the three countries in their response to COVID-19, there are a few issues that should be discussed to better prepare for any future pandemic. One of the major issues is vaccination. Since the COVID-19 situation in the three countries had been relatively stable as compared to other high-income countries around the world, there was not enough motivation to take a risk possibly expected from vaccination. However, a drastic rise in virus cases since May 2021 has changed

the public sentiment. Still, there was not enough stockpile to go around in the beginning.<sup>5</sup> Moreover, COVID-19 increased the vulnerability of society, especially among the socially and economically disadvantaged.<sup>26</sup> The pandemic also worsened income inequality in the ROK due to social distancing rules. The Gini coefficient of the country rose by 0.009 points in 2020.<sup>27</sup> In Singapore, large infection clusters were found in cramped dormitories of foreign workers who were hired on work permits for construction, cleaning, and service sectors.<sup>7</sup> This showed ongoing inequalities within the society.

In this study, we discussed the effective responses of ROK, Taiwan, and Singapore to COVID-19 through three different perspectives—governance, health, and social distancing. Most of all, these countries took appropriate initial countermeasures to control the spread of COVID-19. However, various non-pharmaceutical interventions (NPIs) in the early stage of the pandemic were criticized due to the enormous socio-economic losses. Therefore, a suitable combination of NPIs with less disruptive and costly measures is essential for countries to forecast the effectiveness of future interventions.<sup>28</sup> The pre-COVID-19 preparation based on previous experiences equipped the three aforementioned jurisdictions with resilient public health systems and advanced ICT infrastructure. Public acceptance based on the Confucian culture helped authorities to swiftly implement control and prevention measures. Nevertheless, the three countries still have to improve in terms of vaccination as well as inequality as seen during the COVID-19 situation to be better prepared for any future pandemic.

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