PARTECIPAZIONE e CONFLITTO
The Open Journal of Sociopolitical Studies
ISSN: 1972-7623 (print)
ISSN: 2035-6609 (online)
Coordinamento SIBA - University of Salento

PArtecipazione e COnflitto
http://siba-ese.unisalento.it/index.php/paco
ISSN: 1972-7623 (print version)
ISSN: 2035-6609 (electronic version)
PACO, 14(1) 2021: 79-112
DOI: 10.1285/i20356609v14i1p79

Published 15 March 2021

RESEARCH ARTICLE

Governing a Pandemic with Data on the Contactless Path to AI: Personal Data, Public Health, and the Digital Divide in South Korea, Europe and the United States in Tracking of COVID-19

June Park
East Asia Voices Initiative Fellow, East Asia National Resource Center
Elliott School of International Affairs, The George Washington University

ABSTRACT: Is conditional and temporary collection of data necessary in a public health crisis for democracies? This article attempts at examining the institutional variance in digital tool deployment to contact trace COVID-19 across six different democratic systems: South Korea, Europe (Germany, France, Italy and the UK post-Brexit) and the U.S. It aims at projecting varied country strategies in embracing the digital economy of the future driven by artificial intelligence (AI) as the contactless economy becomes the norm. Europe and the U.S. have refrained from a centralized contact tracing method that involve GPS data collection and used a minimalist approach utilizing apps based on Google and Apple's Application Programming Interface (API) enabled by Bluetooth technology downloadable only voluntary by citizens, with western European countries striving to abide by the General Data Protection Regulation (GDPR), in turn failing to flatten the curve earlier on during the COVID-19 pandemic. Meanwhile, South Korea's maximalist approach of digital tracing utilizing big data analysis on the centralized COVID-19 Smart Management System (SMS) platform and apps on self-diagnosis and self-quarantine under the Infectious Disease Control and Prevention Act (IDCPA) – revised in the aftermath of the Middle East Respiratory Syndrome (MERS) in 2015 – led the country to flatten the curve at an early stage. In addressing the gaps among varied approaches, this article analyzes the legal foundations and policy rationale for conditional and temporary data collection and processing across jurisdictions.

KEYWORDS: South Korea; Europe; United States; COVID-19; Technology; Contact Tracing; Contactless Economy; Personal Data; Civil Liberties; Public Health; Digital Divide; Artificial Intelligence; General Data Protection Regulation (GDPR); Infectious Disease Control and Prevention Act (IDCPA)

CORRESPONDING AUTHOR(S): June Park jpark12@gwu.edu

1. Introduction: Entering the Contactless Economy under COVID-19

1.1. The Quest for Saving Lives and Defending Civil Liberties in Democracies

Should conditional and temporary location data be collected for public health crises such as COVID-19? What constitutes a public health emergency? How did the regulatory measures for digital tracking of COVID-19 come about, and is there any room for reshaping the existing policies for implementation? To answer these questions, this article investigates the legal foundations and methods of implementation of digital tracking by South Korea, Europe and the U.S. to ascertain whether there is policy space to strike a balance between public health safety and data privacy in the event of an outbreak (Abeler *et al.*, 2020).

The pandemic has fundamentally transformed the way of life, and the varieties of pandemic governance in digitally tracking the virus laid bare the digital divide and the stark differences across jurisdictions about the degree of permissibility in data collection and processing. The pandemic has raised questions in democracies regarding the choice between public health safety and data privacy. In Europe and the U.S., the discourse on protecting personal information of citizens was largely fixated on the notion of civil liberties – or individual rights protected by law from unjust governmental or other interference in ordinary people's lives. The discourse on defending civil liberties in the free world against big governments in the COVID-19 era has also surfaced on multiple fronts throughout the society, in the form of public protests on mandated mask-wearing guidelines, forced closures and lockdowns (Parker *et al.*, 2020). As of this writing, the policy discourse is now expanding into the realm of vaccine politics, whereby COVID-19 vaccine procurement and distribution are convened via contracts with national governments in parallel with the COVAX Facility arrangements, with high rates of vaccine hesitancy remaining in several jurisdictions.

As unprecedented death tolls and infection rates are witnessed in Europe and the U.S., the reproduction ratio number of COVID-19 remains relatively low in Asian democracies such as South Korea. A year into the pandemic, notably in Europe, the soaring number of infections during the third wave of COVID-19 has led to a series of lockdowns and left strains on the economy. As South Korean health authorities placed elevated social distancing measures in response to the third wave but far from a complete lockdown, then maintained the measures as the country went about expediting its vaccination program, the fact that South Korea has never gone under a serious lockdown has gradually drawn international attention on the country's pandemic governance. As far as the discourse on pandemic governance goes, assessments on political regime type or regional groupings by continent to conveniently depict on the variance of pandemic governance are at play. However, an assessment on pandemic governance based on the varying degrees of digitalization, the legalization of tech use, or the public acceptance of technology (or the lack of it thereof) to fight the virus, has received little limelight, and deserves serious scholarly attention at a time when the contactless economy is emerging in the time of COVID-19.

1.2. Varied Regulations on GPS Data Collection for Public Health Emergencies across Democracies on the Path to AI

The deployment of artificial intelligence (AI) in pandemic governance in South Korea has led to crucial contributions in controlling the virus. South Korea managed to flatten the curve earlier upon the COVID-19 outbreak in large part due to the rigorous real-time polymerase chain reaction (RT-PCR) testing scheme, of which some test-kits, notably by Seegene were developed by big data analysis conducted by supercomputers

in anticipation that South Korea would be hit, based solely on the ribonucleic acid (RNA) information online[1] prior to the discovery of patient zero in South Korea.[2] AI also played a role in mass producing and error-detecting of the test-kits in the smart factory system set up by Samsung Electronics.[3] Such policy moves on automation and AI deployment during COVID-19 in South Korea are not a surprise when one considers that the country had been focusing and investing on expanding the internet environment and digital infrastructure in the past two decades. What is often understated in explicating the South Korean case is the role of technology – notably big data analysis involving AI – and the legal grounds of the implementation that play a significant role in South Korea's COVID-19 pandemic governance, whereby lessons learned from a prior experience of another coronavirus outbreak – the Middle East Respiratory Syndrome (MERS) in 2015 – led to the prompt response and execution of testing and tracking of COVID-19 (Park and Chung, 2021). MERS served as a critical juncture in which the limitations of manual contact tracing was unveiled, and the need for digital contact tracing surfaced, paving the way for revision of the *Infectious Disease Control and Prevention Act* (IDCPA) post-MERS.[4] The IDCPA allows for health authorities to access personal data on a conditional and temporary basis, which is embedded in South Korea's electronic contact tracing of COVID-19. South Korea's *Personal Information Protection Act* (PIPA)[5] has been in force in tandem with the IDCPA to balance against the negative consequences of the invasion of personal privacy, if and when such an event should arise in pandemic governance efforts.

But this is precisely where South Korea's tech-enabled pandemic governance, albeit based firmly on the IDCPA, becomes almost a 'non-starter' for most European and American observers (Bradford, Aboy and Liddell, 2020; Chan, 2020; Coghlan, Cheong and Coghlan, 2020; Morley *et al.*, 2020; Vandamme and Nguyen, 2020). South Korea's centralized electronic tracking system, dubbed "The COVID-19 Smart Management System" (hereafter SMS), was launched in March 2020, enabled by the smart city application platform that had been in the works by the Ministry of Land, Infrastructure and Technology (MOLIT) for years pre-COVID-19, coupled with the enforcement of the country's self-assessment and self-quarantine apps use at the border. The reluctance in Europe and the U.S. on deploying such rigorous, big data-enabled tracking system stems from dissent on the method of data collection and the processing of credit card history and GPS data (short for Global Positioning System data) – which is location data given by a satellite navigation system used to determine the exact ground location of an object.

It is at this intersection of critical scholarly and policy debates on COVID-19 digital tracing that this article builds its contextual framework upon, in an effort to address institutional variance in data governance in the contactless COVID-19 era and to propose policy recommendations going forward. As the importance of COVID-19 tracking came to light and various apps unfolded across democracies and beyond, differences in the regulatory measures on data collection and management were revealed by how countries chose to digitally trace the virus as part of their pandemic governance. This article presents a framework for understanding why

[1] 'Novel 2019 coronavirus genome: SARS-CoV-2 coronavirus,' January 6, 2020. https://virological.org/t/novel-2019-coronavirus-genome/319

[2] Ivan Watson, Sophie Jeong, Julia Hollingsworth and Tom Booth, 'How this South Korean company created coronavirus test kits in three weeks,' CNN, March 13, 2020. https://edition.cnn.com/2020/03/12/asia/coronavirus-south-korea-testing-intl-hnk/index.html

[3] Ho-Kyeong Kim, 'Samsung helps reduce faulty test-kits amid virus outbreak,' Dong-a Ilbo, June 11, 2020. https://www.donga.com/en/article/all/20200611/2088320/1/Samsung-helps-reduce-faulty-testing-kits-amid-virus-outbreak

[4] Infectious Disease Control and Prevention Act. Act No. 17067, as amended on Mar. 4, 2020. The Republic of Korea. https://elaw.klri.re.kr/kor_service/lawView.do?hseq=53530&lang=ENG

[5] Personal Information Protection Act. Act No.11990, as amended on August 6, 2013. The Republic of Korea. https://www.law.go.kr/LSW/lsInfoP.do?lsiSeq=142563&viewCls=engLsInfoR&urlMode=engLsInfoR&chrClsCd=010203#0000

democracies went about different ways in COVID-19 tracking – the technicalities, the mechanisms and above all, the legal provisions across jurisdictions that impacted or predetermined the ways in which digital tracking methods were adopted. By conducting a comparative analysis of the COVID-19 tracking across democracies, this article intends to fill the research gap in the literature on data governance which has thus far focused primarily on GPS data and privacy control, and further develops the thesis on conditional data collection and processing by incorporating discussions on tracking and AI systems, in anticipation of its rapid evolution that would quickly unfold in the post-pandemic digital economy.

For most European observers of the South Korean digital tracking model epitomized by SMS, the standard rule for digital data collection and use is set by the European Union's *General Data Protection Regulation* (GDPR), which has been in force since May 25, 2018 as the EU's main legal foundation on data privacy and the most comprehensive and thorough legal mechanism in the world on personal data protection. In April 2020, when a pan-EU discussion on developing a COVID-19 app fell through and European countries opted to launch each of their own digital apps around June 2020, the GDPR was the main standard, as even those that pondered upon a centralized method shied away from the idea. Italy, Germany and the UK eventually opted for a Bluetooth-enabled tracking app development based on the application programming interface (API) provided by Google and Apple after negotiations, while France opted out and instead launched a self-developed, Bluetooth-enabled app. In Europe, ensuring that the digital tracking methods are consistent with GDPR – that GPS data is never collected or used, and that digital app downloads and usage depend entirely on the voluntary will of the citizen – has led to difficulties in yielding positive effects of the technology. In July 2020, the Council of Europe proposed a draft legislation to revise GDPR, in consideration of the severity and magnitude of the current crisis and has opened it up for EU member states to comment.[6][7]

Meanwhile, in the U.S., the remnants of the Snowden affair in 2013 have brought down the confidence in the government among the American public when it comes to data collection and processing of its citizens. During the pandemic, both Google and Microsoft have been involved in the development of COVID-19 tracking systems.[8] Microsoft has been working with national, state and local healthcare authorities, partnering with the U.S. Centers for Disease Control (CDC) on a Coronavirus self-checker tool and a Coronavirus tracker powered by its search engine Bing (Bing COVID-19 Tracker) based on the seven principles of data collection and processing.[9] On being referenced as developing a web portal on tracking COVID-19 by the Trump administration in April 2020, Google clarified its position by stating that its sister company Verily, under Google's parent company Alphabet, is developing the pilot portal.[10] As in the case of Europe, the policy debate

[6] 'Proposal for a Regulation of the European Parliament and of the Council concerning the respect for private life and the protection of personal data in electronic communications and repealing Directive 2002/58/EC (Regulation on Privacy and Electronic Communications),' Presidency discussion paper, Council of the European Union, July 6, 2020. https://data.consilium.europa.eu/doc/document/ST-9243-2020-INIT/en/pdf

[7] 'Proposal for a Regulation of the European Parliament and of the Council concerning the respect for private life and the protection of personal data in electronic communications and repealing Directive 2002/58/EC (Regulation on Privacy and Electronic Communications,' Progress report, Council of the European Union, November 20, 2020. https://data.consilium.europa.eu/doc/document/ST-12891-2020-INIT/en/pdf

[8] 'U.S. government, tech industry discussing ways to use smartphone location data to combat coronavirus,' The Washington Post, March 17, 2020. https://www.washingtonpost.com/technology/2020/03/17/white-house-location-data-coronavirus/

[9] 'Preserving privacy while addressing COVID-19,' The Official Microsoft Blog, April 20, 2020. https://blogs.microsoft.com/on-the-issues/2020/04/20/privacy-covid-19-data-collection/

[10] John Timmer, 'Google and Verily clarify their roles in the US coronavirus response,' ArsTechnica, March 16, 2020. https://arstechnica.com/science/2020/03/google-contradicts-trump-claims-its-not-working-on-a-coronavirus-portal/

on digital tracking of COVID-19 in the U.S. also appeared to be wary of the collection of GPS data from smartphones and instead was in support of the Google-Apple API, but implementation varied across states.[11]

1.3. The Digital Divide: The Fundamental Question about Digitalization and AI

In a broader spectrum of debates, the varied approaches manifested in the methods that countries opted for in digitally tracking COVID-19 reveals that the question at large is not only about data governance in a public health crisis, but more profoundly on digitalization itself and the public response to it. Strictly put, in Europe, having the public so averse to digital tools to control the virus using electronic tracing methods is a hurdle, and the reality is that such tracking systems relying on big data analysis would be difficult to achieve without the required infrastructure. Without high-speed internet connectivity that enables ubiquitous data collection to track the virus coupled with nationwide smartphone usage by most of the population, implementing such a system is unfathomable.

European countries, for the most part, vary significantly in smartphone usage rates and access to high-speed internet, as do many states in the U.S. Such questions regarding the digital divide may only be pronounced as the contactless economy is accelerated under the prolonged COVID-19 era. The variance in data governance and the method of approach in digital tracking tells us that for a widespread, proper implementation of AI in public health (Benke and Benke, 2018), de-identification and anonymization of personal data would be crucial in areas such as medical AI. For the time being, as much as the nature of COVID-19 is highly infectious and lethal for those with preexisting conditions, and as the virus leads to exponential number of cases from chain infections, manual tracing method alone does not suffice. Without an effective digital tracking system, one can only expect more deaths in the near term as the virus and its variants continue to spread.

To comparatively examine the efficacy of the current COVID-19 tracing apps in combatting COVID-19 across jurisdictions, this article develops a conceptual framework of legal foundations, underpinnings of public health emergency and personal data protection regulations in South Korea, Europe and the U.S. Such research endeavors on data governance would allow us to envision how the diversity of regulatory systems on data would look like in an economy dominated by AI in the future. Following the introduction section, the second section lays out a conceptual framework detailing varied data governance in COVID-19 tracking and strategies in artificial intelligence. The third section presents the argument on the need for conditional data collection to fight COVID-19, and the fourth section explains the data and methodology deployed for the research. The fifth section presents the findings from comparative analysis with policy implications, and the sixth section concludes.

2. Conceptual Framework of Varied Data Governance in COVID-19 Tracking and Strategies in AI

2.1. Legal Foundations for Digital Contact Tracing: Varied Regulations on Data Collection and Processing across Democracies

2.1.1 Varying Regulatory Mechanisms on Personal Data Protection

[11] Ashkan Soltani, Ryan Calo, and Carl Bergstrom, 'Contact tracing apps are not a solution to the COVID-19 crisis,' TechStream, the Brookings Institution, April 27, 2020. https://www.brookings.edu/techstream/inaccurate-and-insecure-why-contact-tracing-apps-could-be-a-disaster/

As much as countries have differed on the digitalization processes and experiences, the legal foundations on data privacy are not uniform and vary across jurisdictions. There is no single global regulatory framework on data governance. By enacting GDPR, the EU has attempted at setting the global standard for data privacy, and the scope of the application of GDPR is not limited to the EU's territorial borders (Voigt and von dem Bussche, 2017). The GDPR focuses on protecting the data privacy of individuals, regardless of nationality or place of residence, thereby intending to prevent 'forum shopping' across EU member states of varying data protection standards. Nonetheless, while the scope of the GDPR transcends across the EU's borders, other nation states have installed within their jurisdictions their own data protection regulations under national laws, or are either in development of such law or without such law. In other words, due to the varying degrees of development in digitalization, a global mechanism for data privacy has yet to be developed, or perhaps may never be developed. As data governance becomes a central part of global trade – specifically pertaining to data transfers, control and processing – it is very likely that countries would continue to vary in their legal foundations in developing data privacy mechanisms, while at the same time abiding by GDPR or failing to do so within the scope of its application.

2.1.2 Varying Regulations on Governing Infectious Diseases and Public Health Emergencies

When there are varying legal mechanisms as to how data is governed, countries also vary on determinations regarding exceptional circumstances under which data collection is deemed necessary (i.e., in the case of GDPR, in the areas of security policy or criminal prosecution). More importantly, countries vary significantly on what constitutes a public health emergency in their national laws, and the criteria for announcing national emergencies. The enactment of such regulations is much beholden to the country's own experiences of national crises, be it public health or economic crises, or war. For instance, in Europe, it is well understood by countries that have experienced totalitarian rule via the declaration of national emergency or martial law – whereby previously the government has seized control of private citizens' lives by having access to their information – that they should distance themselves from allowing the government access to such data, even under an emergency. Such reluctance toward government control of personal data was further reinforced by the Snowden affair (Farrell and Newman, 2019) –under which the U.S. government's spying programs and surveillance tactics were revealed – as well as the Facebook-Cambridge Analytica scandal, which has indeed stirred controversy and anger in Europe. Nonetheless, the limitations of GDPR during the COVID-19 pandemic demonstrates that the lack of detailed guidelines on the exceptions of GDPR in times of public health emergencies, can lead to repeated failures in future pandemics, particularly in the case of infectious diseases.

In analyzing the case of South Korea, it is worth noting that the IDCPA is very comprehensive in its implementation, in that the law encompasses not only the collection of data on a conditional basis in a pandemic, but also free testing nationwide (Table 5). The IDCPA provided the legal grounds for the early response by a public-private partnership scheme between South Korean firms in in vitro diagnostics (IVD) on RT-PCR test-kits via submission of products, assessment and approval for emergency use approval (EUA), and smart factory operation by Samsung Electronics for large-scale production of the kits for nationwide distribution at test sites (Park and Chung, 2021). The massive testing scheme helped identify the virus locations and patients at a rapid pace in a streamlined manner, leading to effective tracing by SMS and contributing to the overall control of the COVID-19 pandemic in South Korea (Park, June, 2021).

2.1.3 Degree of Public Acceptance on Personal Data Sharing

As in other continents, the degree of public willingness to share data varies considerably. As the discourse on data privacy unfolded prior to the launch of COVID-19 tracing apps in Europe, much of the focus centered on the degree of public acceptance of an app that may be found in violation of GDPR. As discussed in the next section on the method of personal data collection, Germany, a central player in the EU, made sure that the roll-out of COVID-19 tracing apps would be in line with GDPR. Three years since its implementation, more people are becoming aware of ways to protect their personal data under the GDPR, but its broad scope for enforcement constantly puts the GDPR back on the testing board.[12][13] Furthermore, the implementation of GDPR still has a ways to go in many parts of Europe, due to the variance of public acceptance levels in data sharing. For instance, prior to the implementation of GDPR, reports from private consulting firms and surveys revealed that European citizens varied in their acceptance to share data, evidenced by varying market growth levels in motor insurance products that have data sharing schemes (Rush and de La Bellière, 2016).

What became clear in the COVID-19 pandemic is that the precedence of major infectious diseases played a critical role in the preparation for future outbreaks, and in this regard Asian countries have benefitted from prior experiences. The willingness to share data or the mandated sharing of data to fight infectious diseases written into existing laws or new laws are primarily based on these precedents. Prior to the COVID-19 pandemic, what the European and the U.S. public lacked was the experience of massive deaths from infectious diseases. Notably in Germany, public sensitivity to granting government entities access to personal data, played a crucial role in the country's turnaround in policy to reject a centralized method for digital contact tracing. The EU's strong advocacy of GDPR also prevented the conditional use of data to contain the virus from the early stage of the pandemic. With the GDPR in its nascence and in force only for the previous two and a half years when the COVID-19 outbreak hit, the EU was not prepared and its main drive to protect the norms of GDPR was met with the challenges of requiring personal data of EU citizens and administering them in order to prevent the spread of COVID-19.

2.2. Digital Contact Tracing: Varied Methods in Personal Data Collection based on Regulations

2.2.1 Method of Data Collection and Processing: Centralized vs. Decentralized Apps

At the crux of the debate on centralized apps and decentralized apps for digital tracing of COVID-19, three main issues are in a mix: security and privacy concerns, technical limitations and the market positions of Google and Apple as providers of smartphone operating systems (Ciucci and Gouardères, 2020; Sharon, 2020). First, on the most fiercely debated issue regarding security and privacy concerns, while both methods can utilize Bluetooth for exchanging a key code between smartphones, the centralized method for exposure notification entails the smartphone providing its own anonymized ID in addition to codes gathered from other phones to the centralized database, whereas the decentralized method prompts the smartphone to provide its own anonymized ID only to the central database. Then, in the case of the centralized method, the computer server uses a central database to conduct contact matching and risk analysis to send out exposure notification alerts, while in the decentralized method, the user's smartphone downloads the database for the same goal.

[12] Press release, 'General Data Protection Regulation: one year on,' European Commission, May 22, 2019. https://ec.europa.eu/commission/presscorner/detail/en/IP_19_2610

[13] Press release, 'General Data Protection Regulation shows results, but work needs to continue,' European Commission, July 24, 2019. https://ec.europa.eu/commission/presscorner/detail/en/IP_19_4449

The centralized apps are deemed to be in favor of giving more insight to public health authorities while the decentralized apps are considered to provide a higher degree of privacy (Criddle and Kelion, 2020).

Second, regarding technical limitations, the main issue was centered on the features of the Bluetooth function on Apple's iPhones, as they did not allow centralized apps running in the background to obtain and upload the history of all observed contacts under iPhone settings pre-iOS 13.5. In order to perform the Bluetooth function on centralized COVID-19 apps in the foreground, Apple would have needed users to do so on unlocked mobile devices (as if the iPhone is locked or the user is not looking at the app, in which there would be no Bluetooth signal), which would result in significant impact on battery duration for users. What were perceived as technical limitations in running centralized apps on mobile devices were features built into iPhones in response to previous issues that Apple encountered, such as targeted advertising with Bluetooth running in the foreground (Newton, 2020; Vincent, 2020). Android phones with the latest versions of operating systems have similar restrictions, whereby Bluetooth signals are sent out only for a few minutes after the user has closed an app.

Third, the collaboration between the global tech companies, Google and Apple, to come up with an application programming interface (API) attests to further emboldened leverage by global tech companies on the decision-making process regarding tech deployment for public policy purposes. Simply put, Google and Apple as controllers of the operating systems of mobile devices did not want to change the operation system settings for the centralized apps to work. This was a crucial element in the negotiation processes between national governments seeking to launch a COVID-19 tracing app on mobile phones and the two tech giants.

Notably, South Korea's case does not fall under the Google-Apple API oriented system, as its indigenously developed centralized system of the SMS by MOLIT does not require an app for the tracing mechanism *per se* and is rather conducted within the SMS portal. Other mechanisms that entail GPS data collection and use, such as South Korea's apps for self-quarantine and self-diagnosis upon border entry, deploy a centralized method for operation that are developed by the Ministry of Interior and Safety as well as the Korea Disease Control and Prevention Agency (KDCA), and operate on a mandatory basis for those entering the South Korean border.

2.2.2 Designation of App Developer, Quality and Download Rate Variations from Non-Enforcement

In coming up with apps for COVID-19 exposure notification, countries also varied in their choice of app developers. Once the Google-Apple API was provided as open source, countries delegated the task of app development to the private tech companies in their jurisdictions, or public tech organizations within the bureaucracy (i.e., France's INRIA). This not only means that the quality of each app varied considerably across EU member states and U.S. states, but also that interoperability in the EU or the U.S. as a whole was significantly compromised, as the apps are by jurisdiction only and exposure notification would not occur when citizens travel across borders between EU member states (Ciucci and Gouardères, 2020) or U.S. states. Moreover, because protecting the privacy of the users was one of the core elements for developing such apps, notably in Europe under GDPR, there was no enforcement measure on the usage of the apps, let alone downloading them, as opposed to pre-launch estimations on the download rates (Altmann *et al.*, 2020). COVID-19 tracking app downloads were voluntary also in the U.S. and the UK. Download rates varied considerably among EU member states as well as states in the U.S., with frequent complaints by users regarding the functionality of the apps.

2.2.3 Infrastructure and Critical Mass: The Minimum Requirements for Effective Tracing Apps

Another limitation to the use of COVID-19 exposure notification apps in Europe and the U.S. was the lack and variance in infrastructure as well as the critical mass of smartphone holders. As the 5G race unfolds in many parts of the developing and developed economies, connectivity and network infrastructure varies by country – particularly on wireless broadband penetration rate, number of internet users, and bandwidth speed – and it is easily noticeable that none of the western European economies of observation in this article – Germany, France, Italy or the UK – are within the top 10 ranks in digital competitiveness globally (Table 1).[14] Smartphone usage rates also vary across advanced economies globally. Before the COVID-19 outbreak in 2018, France and Italy's figures of smartphone ownership rates were lower than the median of advanced economies (Figure 1).[15]

A critical mass of smartphone users and network infrastructure are the basic requirements for contact tracing apps to be effective (Wetsman, 2020). Rapid, stable and secure connectivity with a wide coverage for mobile devices used are the basic requirements for tracing apps to reap meaningful results when used by users upon consent. In a study that has conducted a modeling on the 15% of the population participating in digital exposure notification system use, it has been found that such systems could reduce infections and deaths by approximately 8% and 6%, respectively, complementing traditional contact tracing (Abueg *et al.*, 2020). Nonetheless, within the EU where the GDPR supersedes, the voluntary nature of the COVID-19 tracing apps operating on the Google-Apple API meant that in the absence of an enforcement mechanism, it would severely lack capacity in mobilizing a critical mass of users needed for effective implementation.

Table 1 – Digital Competitiveness Rankings, 2020

Rank	Overall	Knowledge	Technology	Future Readiness
1	USA	USA	Singapore	Denmark
2	Singapore	Singapore	Hong Kong, SAR	USA
3	Denmark	Switzerland	Norway	Republic of Korea
4	Sweden	Sweden	UAE	Netherlands
5	Hong Kong, SAR	Canada	Taiwan	Switzerland
6	Switzerland	Denmark	Sweden	Norway
7	Netherlands	Hong Kong, SAR	USA	Sweden
8	Republic of Korea	China	Netherlands	Taiwan
9	Norway	Israel	Denmark	Finland
10	Finland	Republic of Korea	Finland	Hong Kong, SAR

Source: *IMD World Digital Competitiveness Ranking*

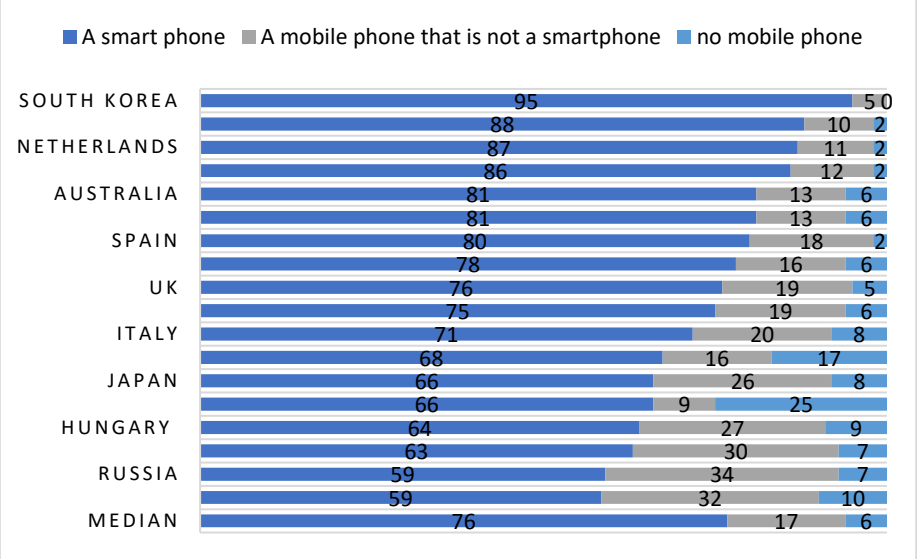
2.3. The Logic of Consent: Between Mandatory and Voluntary Implementation

[14] IMD World Digital Competitiveness Ranking, 2020. https://www.imd.org/wcc/world-competitiveness-center-rankings/world-digital-competitiveness-rankings-2020/

[15] Mobile penetration rate, World Bank Indicators, the World Bank https://databank.worldbank.org/Mobile-penetration-/id/5494af8e#

There is a discrepancy in the policy outcome between mandatory and voluntary implementation of data sharing, based on the logic of consent in a pandemic situation. In addition, a blurry line exists between sharing data with private companies and public authorities. What we have witnessed in Europe and the U.S. as the COVID-19 apps were rolled out for use on a voluntary basis, is citizens opting out of data sharing for several reasons, and citizens that have opted in not benefitting from the app due to the lack of critical mass among other issues. The situation is otherwise in the private sector, as evidenced by the circumstances in which the option to share data (GPS location, speed, braking, etc.) for discounts on motor insurance programs is becoming a boon for insurance companies, and those that opt in are customers that see the immediate benefits of sharing the data in economic terms. Meanwhile, the long-term consequences of not opting in to share any data to help ensure public health safety can be detrimental, as the pandemic is lengthened, and can bring about further lockdowns, resulting in further societal and economic impact on the livelihood of citizens as witnessed in several parts of Europe (Bruns, Kraguljac and Bruns, 2020). While no economy has been untouched by the COVID-19 pandemic, South Korea has not gone on a full-scale lockdown and its borders remained open, in large part relying on the existence and operation of SMS, as well as mandatory self-quarantine and self-diagnosis apps for tracking efforts.

Figure 1 – Smartphone ownership in advanced economies 2018



Source: *Smartphone usage rates in advanced economies from Laura Silver, "Smartphone Ownership Is Growing Rapidly Around the World, but Not Always Equally," Pew Research Center Spring 2018 Global Attitudes Survey, Q45 & Q46, 2018 (% of adults who report owing…), February 5, 2019.* https://www.pewresearch.org/global/2019/02/05/smartphone-ownership-is-growing-rapidly-around-the-world-but-not-always-equally/

The irony of the logic of consent lies in the willingness to share GPS data with private companies for direct economic incentive and immediate gains but not with public health authorities for the lives of others, for the fear of government control among several other reasons. This brings into question not only on how much trust the citizens have for government, but also how much the citizens are willing to sacrifice their personal details to help save lives by controlling the virus. In the case of Europe, of additional concern is the meaning of civil liberties in a public health crisis, as the lengthened lockdowns are deterring personal freedom of movement. Meanwhile, in South Korea, based on the mandatory SMS deployed nationwide, the virus is detected in a speedy manner, albeit with limitations of the system revealed in cases of small cluster infections where data

collection is difficult, as well as faulty testimonies by citizens (which are punishable under IDPCA), which would cause failure to detect the virus using the SMS. In a similar context, the case of the State of California's app, 'CA Notify' or 'California COVID Notify' (Clover, 2020)[16] and Japan's 'COCOA – COVID-19 Contact App' in preparation for the 2021 Summer Olympics (Takeuchi, 2020)[17] raise the same questions regarding the efficacy of COVID-19 apps that are for voluntary use.

2.4. Further Challenges Ahead that will Exacerbate the Digital Divide

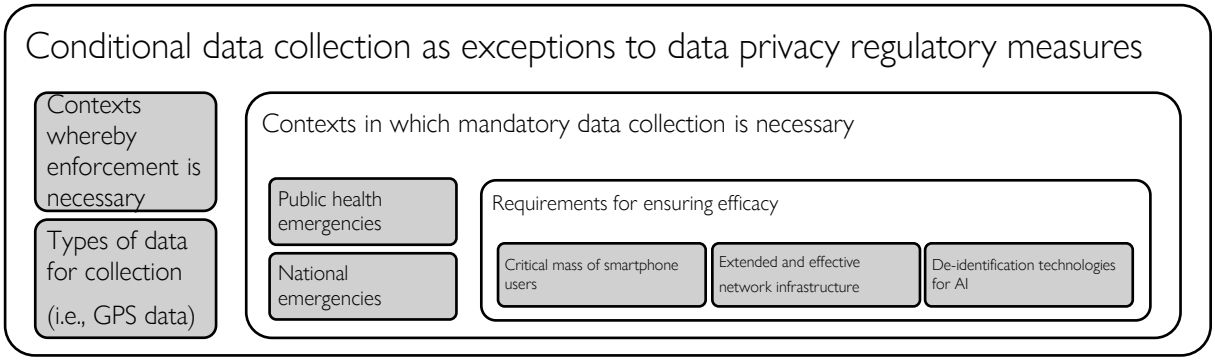
The challenges that lie ahead in future pandemics stem from the digital divide that we are witnessing as the COVID-19 pandemic unfolds. The differences in network connectivity and speed, the varying levels of public acceptance of digitalization, and the adoption of developed AI tools and institutions that approve its deployment will bring about widened gaps in pandemic governance across countries. From testing, tracing, treatment to vaccination, speed and accuracy have been identified as the crucial elements of COVID-19 pandemic governance. Overcoming a pandemic situation based primarily on manual efforts would not be as effective than when digital tracking technology is deployed, and what is more, may not bring about positive policy outcomes. What will be more challenging to tackle is the leverage that the big tech companies possess in many parts of the world (i.e., the decision-making power a) to choose and deploy specific technologies under their desired conditions to solve societal issues and decide which apps would be listed on Google Play and Apple App Store for sale and free downloads; b) to collect data of users with or without consent by users; c) to charge users for the apps developed by them) as the digital divide is exacerbated amongst countries. As the cycles for future pandemics become shorter, with new viruses emerging, countries will be prompted to activate a set of measures for pandemic governance for fast recovery, recognizing the utility of technology that would be beneficial in tracking viruses that spread at a rapid pace.

Figure 2 lays out a framework of the contexts under which conditional data collection can be deployed. The main purpose of the framework is to identify under which circumstances policy efforts should be made to strike a balance between data privacy and public health.[18] Public health crises or national emergencies that may fall under such context can be considered as such circumstances under which mandatory data collection on a conditional basis can be deployed. For implementation, countries must also consider their own domestic factors for deployment and potential consequences (Arakpogun *et al.*, 2020).

Deploying the contextual framework to the case studies, Figure 3 demonstrates how the extant regulations differ amongst the countries of observation, as the varied pathways of policy choice on COVID-19 digital tracking have emanated from data privacy regulations.[19] In addition to the clear dividing factor of prior coronavirus experience between Europe and the U.S. vis-à-vis South Korea, the determinant factor which led to different policy outcomes was the content of the GDPR articles 6 (lawfulness of processing) and 9 (processing of special categories of personal data), which prohibits the collection of personal location or GPS data, while the IDCPA mandates the effort in a pandemic.

[16] 'CA Notify: California can help stop the spread: Add your phone today to California's exposure notification system,' Centers for Disease Control and California Department of Public Health. https://canotify.ca.gov
[17] 'COVID-19 Contact-Confirming Application,' Ministry of Health, Labor and Welfare, the Government of Japan https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/cocoa_00138.html
[18] June Park. 'Tracking COVID-19 in the Age of AI and Tech Wars,' *Asia Pacific Bulletin*, No.517, East-West Center in Washington. July 17, 2020.
[19] June Park. 'Striking a Balance between Data Privacy and Public Health Safety: A South Korean Perspective,' Commentary from *The Evolving Indo-Pacific Trade Environment*, The National Bureau of Asian Research. April 29, 2021.

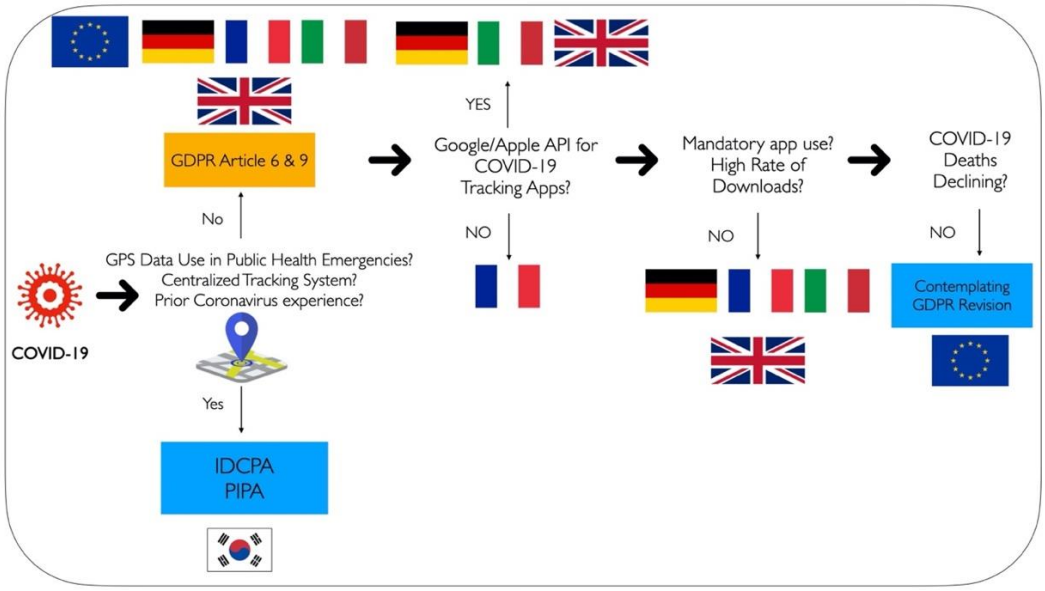
Figure 2 – Contextual Framework of Considerations of Exceptions to Data Privacy Regulations



Source: *By author.*

As Figure 3 portrays, the choices made on the subsequent components of centralized/decentralized tracking methods and the voluntary/mandatory use of the tracking apps were the critical factors that led to the policy outcomes. Consequently, the inefficacy of COVID-19 apps in Europe has led to the push for policy change at the Council of the European Union, to contemplate on a revised GDPR.

Figure 3 – Policy Variation in Adopting COVID-19 Digital Tracking Methods in South Korea and Europe



Source: *By author based on the GDPR and the IDCPA, in addition to government and media sources regarding COVID-19 tracking.*

3. Argument: Conditional data collection as exceptions to data privacy regulations

The rollouts of COVID-19 apps based on the Google-Apple API have revealed the limitations of data governance, when data privacy is prioritized over other criteria in a pandemic situation. In western democracies where data protection for the private citizen is the untouchable component in policymaking toward the adoption of digital technologies to track COVID-19, little policy emphasis was placed on the enforcement mechanism. Had such an enforcement guideline or measure been deployed under the exceptions of data privacy regulations,

it could have helped minimize the number of deaths with the assistance of technology. For democracies around the world, the fear that data privacy would not be guaranteed for private citizens as in autocratic systems such as China could have been overcome.

Democratic governments should be ready to implement a digital tracking mechanism for infectious viruses, whereby GPS data is shared on a conditional basis in a pandemic situation, based on the legal foundations and institutions that they formulate in the course of the COVID-19 pandemic (Braun and Hummel, 2020). COVID-19 has indeed spread in such a rapid pace that manual tracking could not keep up with the speed in epidemiological survey efforts (Ferretti *et al.*, 2020), and there is no guarantee that the spread of future viruses would be slower than COVID-19 in human-to-human infections. In democracies where there are existing personal data protection laws, regulatory measures that allow for conditional data collection can be considered with adjustments of the law in line with pandemic governance efforts (Almeida *et al.*, 2020; Bassi *et al.*, 2020; Ekong, Chukwu and Chukwu, 2020). In the case of a comprehensive data privacy regulatory measure such as GDPR, complementary exemption clauses which specifically state the contexts under which conditional collection of data in a public health crisis would be key in future pandemics. The rationale for such revision in the GDPR is that, while maintaining data privacy for the private citizen is paramount, the meaning of data privacy is not absolute and thus cannot be the ultimate priority when lives are at stake due to the lack of data sharing in a quickly unfolding pandemic situation. There is a balance to be struck between personal data protection and public health safety in Europe and the U.S., by revising the GDPR to accommodate conditional data collection and use only for epidemiological purposes in a pandemic.

The important policy lesson learned in the case of South Korea, where the IDCPA was revised after experiencing MERS, is that lives can be saved in a rapidly unfolding pandemic by early action and deployment of digital tools, utilizing data of which the collection and processing are conditionally allowed in a public health crisis situation. For democracies that have both laws on infectious diseases and data protection laws in place, such as South Korea, where GPS data is already being collected on a conditional basis, the balance between data privacy and public health safety can be struck by ensuring the protection of the private citizen (i.e., minimizing the exposure of the detailed personal identity record of the infected to the general public or the media, as instated in the revised IDCPA enforcement decree Article 22-2, shown in Table 2), to prevent invasion of privacy in the course of conditional data collection for pandemic governance purposes. De-identification in big data analysis and AI along similar lines of public policy purpose would be crucial in this effort.

4. Data and Methodology: Comparative Country Case Studies

This research deploys a comparative country case study and investigates the varied forms of data governance that are embedded in launching COVID-19 tracking apps, with the intent to further envision what the deployment of AI would look like across different countries.

First, the article investigates varied data governance manifested in existing or revised regulations in each jurisdiction, that were set in stone in order to combat COVID-19. It analyzes the methods and approaches taken by countries based on government press releases, national laws and adherence to legal foundations such as the GDPR of the EU, or the IDCPA and PIPA of South Korea, as well as other legislations that are proposed regarding data governance to fight COVID-19 in the U.S. Congress. The pathways and procedures toward choosing a decentralized or centralized method to track COVID-19 and the effects of the methods chosen are demonstrated in detail in the case studies.

Second, the article offers a reality check on the efficacy of the apps by gauging the policy impact of the methods chosen by countries based on their regulatory measures. Public participation in digital tracking is

measured by the rate of downloads for each app released, per population of jurisdiction (Table 3), obtained through Apple App Store and Google Play. The COVID-19 deaths per million per country (Figure 4) are based on data by the Johns Hopkins Coronavirus Resource Center and presented to support the policy recommendation that conditional data collection for epidemiological survey in times of public health emergency is vital to the timely response in a pandemic.

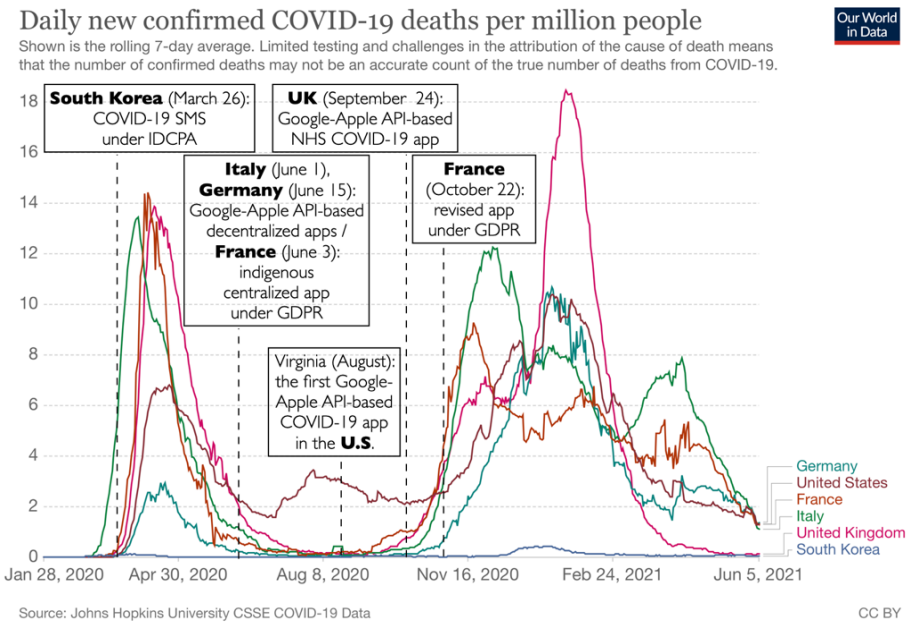
Based on the empirical findings, the article then goes beyond the scope of the research and expands the perspective on data governance to AI as to ascertain whether the goals of global convergence with respect to AI – in the form of the Global Partnership on Artificial Intelligence (GPAI) at the Organization for Economic Co-operation and Development (OECD)[20] – are realistic, and points to de-identification technologies.

5. Findings and Theoretical Implications

5.1. The Varied Paths Towards Digital Contact Tracing of COVID-19

There are two stages as timeframes for each country that are considered in the case analyses: the first stage is the time period for policy-making process on the legislative front by each country from the discovery of Patient Zero in early 2020 to the adoption of a digital tracking method, designated for the observation of the speed and efficacy in policy response; the second stage is from the adoption and launch of the digital tracking tool to the most proximate date of publication of this article (June 2021), to gauge the level of efficacy that digital tracking has had on pandemic governance.

Figure 4 – Timeline Variation in Adopting COVID-19 Digital Tracking Methods for Epidemiological Survey and Cumulative Confirmed Deaths from COVID-19 in South Korea, Europe and the U.S.



Source: *By author based on 'Our World in Data' and government documentations on the specific dates of COVID-19 digital tracking system and app launches.*

[20] The Global Partnership on Artificial Intelligence (GPAI), the Organization for Economic Co-operation and Development (OECD). https://gpai.ai

The exact dates of discovery of Patient Zero in each jurisdiction are indicated in Table 3, and the dates of adoption of digital apps or systems are displayed in Table 3 as well as Figure 4.

Figure 4 demonstrates very clearly that South Korea has benefitted from launching the COVID-19 SMS from the onset of the pandemic, while the efficacy of apps in detecting and controlling the COVID-19 virus in Europe and U.S. remains dubious. The following empirical findings provide a comparative view on how data is deployed differently at varying points in time as countries juggle between data protection and public health safety in a pandemic. The varied data governance provides a glimpse at how the AI strategies would be played out in the COVID-19 era, as the digital economy becomes the norm in the rapid acceleration of technological development under the lengthened pandemic. Below are analyses of cases of countries in chronological order of digital tracking tool deployment date and implementation.

5.1.1 South Korea – MOLIT's COVID-19 Smart Management System (March 26, 2020) and two separate mandatory apps for self-diagnosis and self-quarantine

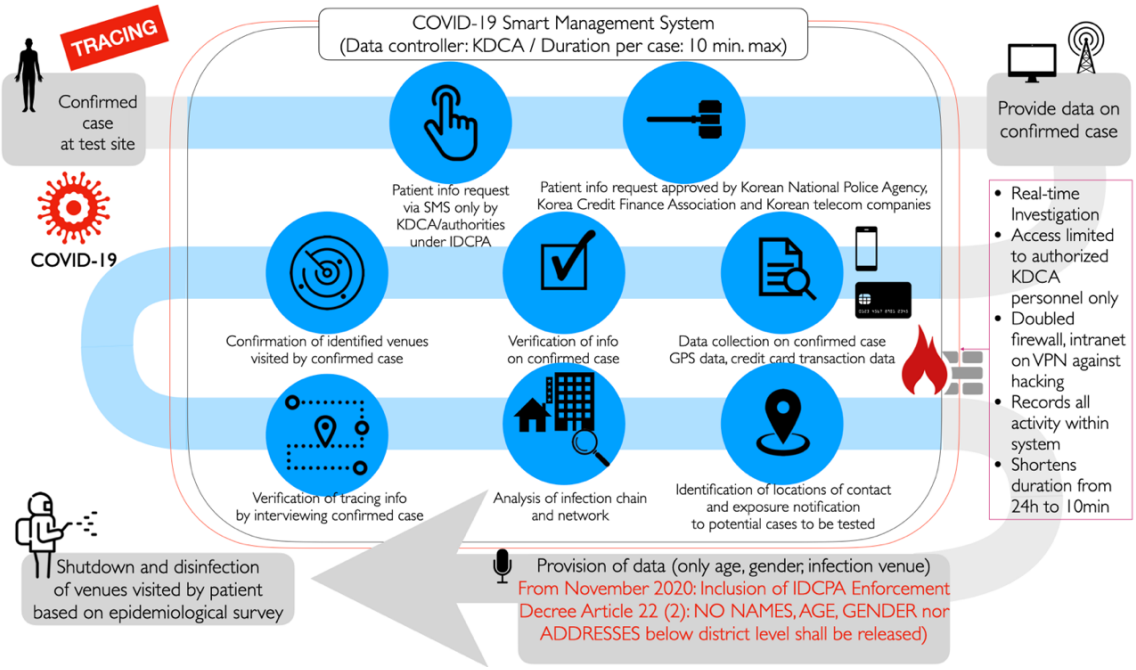
South Korea gained traction from European countries as a case of a democracy deploying digital tools in the pandemic, amid misunderstood criticisms on the 'authoritarian residue' for utilizing GPS data from smartphones, and credit card transaction history for COVID-19 tracking purposes. Upon the discovery of Patient Zero on January 20, 2020, traditional methods of contact tracing took place in South Korea, but when infection cases began to soar, the Ministry of Land, Infrastructure and Transportation (MOLIT) proposed a system for contact tracing as a spin-off of South Korea's existing smart city data hub platform project, catered to conduct big data analyses of transportation, energy, environment, and safety in cities (Greer *et al.*, 2021; Park, June, 2021). Operation of the pilot version of the SMS began on March 16, 2020, then was replaced by the official version launched on March 26, 2020, following the MOLIT's delegation of rights and access to KDCA (Park, Choi and Ko, 2020).

The fact that South Korea's conditional collection for use and deletion of personal data after 14 days of collection to track COVID-19 relied on public demand to bring the situation under control and a social contract written into law in the revised IDPCA (Um, 2020) – combined with PIPA – was largely overlooked by observers from abroad in their assessment of the South Korean pathway toward legalizing conditional data collection during COVID-19. Under the Article 76 of the IDCPA revised after MERS to allow KDCA access to infection data in an outbreak (Table 2) the Korea Police Agency, the Korea Credit and Finance Association, three telecom companies (KT, SKT, LGT) and 22 credit card companies created a cooperative inter-organizational network to operate the SMS, in an effort to ensure accuracy and speed in epidemiological survey (KTV YouTube Channel, 2020a). The biggest change in the epidemiological survey process by the SMS was going from analogue to digital, which expedited the tracing process by shortening the previous 24-hour span of investigation to approximately 10 minutes per case, replacing the traditional intra-ministerial contacting and paperwork among 28 other different organizations that supports KDCA with a smart city technology system. The deployment of the SMS at the early stage of COVID-19 has enabled real-time contact tracing, allowing for KDCA to respond to large cluster infections in a timely manner (Um, 2020).

The goal of the SMS is to utilize conditionally collected personal data for epidemiological survey while ensuring minimal use of personal information. As indicated in Figure 5, there are clear boundaries of the KDCA's access to information (colored in blue), and the GPS data and credit card history data are withheld by private companies (colored in gray), then released upon request by health authorities only when deemed necessary in case of an infection (KTV YouTube Channel, 2020b). GPS data retrieved conditionally from the telecom companies derive from what is remaining at the cellular towers, and CCTV footage is used only in

cases when status of the patient at the time of infection and memory of the patient need to be verified. Access to the SMS is kept within a minimum number of KDCA epidemiological investigators, and the system operates within an intranet that denies access to any other government agency. The SMS has advanced security settings in which the system stands behind a doubled firewall to prevent hacking and deploys the highest levels of network security for logins, with activity logs within the system recorded and maintained.

Figure 5 – South Korea's COVID-19 Smart Management System (SMS)



Source: *By author based on daily KDCA briefings on KTV Channel and other sources (Lee and Lee, 2020; Park, Choi and Ko, 2020; Um, 2020; Yoon, 2020).*

Similar data collection and big data analyses were made in Taiwan upon the disembarkment of the Japanese passengers from the infected Diamond Princess cruise ship (C.-M. Chen et al., 2020), and an e-Outbreak platform suggested by Taiwanese scholars feature some similarities in the mechanism (W. J. Chen et al., 2020). Upon the joint KDCA/MOLIT press briefing on the SMS for some 30 foreign media personnel, it was announced that the South Korean government would consider providing consultation on the system for other countries (KTV YouTube Channel, 2020b). However, there have not been any updates on exporting the system to other countries, presumably due to the varied data governance and regulations. Although South Korea's SMS is strictly in line with IDPCA and PIPA, it would not be fit for application in Europe, as GPS data collection and use would be prohibited under the current version of GDPR if articles 6 and 9 remain in current form.

5.1.2 European Union – Pan-European Privacy-Preserving Proximity Tracing (April 1, 2020)

Unlike in Asia, prior to the launch of COVID-19 exposure notification apps enabled by Google -Apple API, most apps in Europe and North America were for information dissemination purposes and not necessarily for

tracking purposes (Collado-Borrell *et al.*, 2020). In the early stage of the pandemic, there were concerns that COVID-19 contact tracing would put the EU's GDPR to the test (Manancourt, 2020). Upon the outbreak across EU member states, mobile data was shared by mobile carriers with health authorities to detect whether people are complying with confinement measures within the boundaries of GDPR (Pollina and Busvine, 2020). Then, upon encountering electronic tracing methods in several Asian states used to identify confirmed cases of COVID-19, European states considered launching their own apps that would use Bluetooth technology without collecting GPS data. Given the rapid reproduction pace of COVID-19, European states had to come to the realization that electronic tracing is inevitable.

At the EU level, Germany had advocated the idea of a centralized standard called Pan-European Privacy-Preserving Proximity Tracing (PEPP-PT) with the backing of a coalition of EU scientists and technologists. Had it been deployed, the PEPP-PT, a "privacy-preserving" standard – as they do not require location data to be collected – for centralized and decentralized Bluetooth-based proximity tracking to detect COVID-19 infection risk, would have required Google and Apple to make changes to the decentralized API they were designing (Lomas, 2020). Initial discussions at the EU level were held in April 2020, envisioning a pan-EU app for all EU countries, but such discussion quickly evaporated and countries chose to go about their own ways to implement decentralized apps based on the resolution adopted (European Parliament, 2020). The reception of these separate apps by EU member states varied significantly across borders, as seen in the rate of downloads.

At the EU level, the interoperability of different apps across member states was seen as the main shortcoming and the EU Interoperability Gateway was announced on October 19, 2020, to exchange temporary exchange keys (TEK) from apps based on the Google-Apple API. While such efforts are intended to streamline data sharing within the auspices of GDPR, physical limitations have been identified in the interoperability of the apps using the Italian app Immuni, the Swiss app SwissCovid and Germany's Corona-Warn-App, whereby little correlation between Bluetooth received signal strength and distance between mobile devices (Leith and Farrell, 2020).

5.1.3 Italy – The Immuni App (June 1, 2020)

In Italy, the utility of contact tracing (Fateh-Moghadam *et al.*, 2020; Giordano *et al.*, 2020; Mandić-Rajčević *et al.*, 2020) combined with lockdowns and testing (Peto, 2020) gained traction and a government task force set to work towards the launch of an app (Ministro per l'innovazione Technologica e la Digitalizzazione, 2020). From the onset, Italy's Data Protection Agency (DPA) had underlined that employers should not go it alone as data controllers in the collection of data, and that they must comply with the directions by the Italian Ministry of Health (Garante per la Protezione dei Dati Personali, 2020). In addition, calling for the transparency, access and rigor of scientific models, Italian researchers have also argued that stakeholders should improve the rapidity with which data from trusted sources are released to the community in a fully responsible manner (Squazzoni *et al.*, 2020). Italy was the first to launch its own app, 'Immuni' (Presidenza del Consiglio dei Ministri, 2020) with the Google-Apple API source code in Europe, pilot-testing in four regions of Italy before going nationwide, but on a voluntary basis, and without much public response.

In the course of launching Immuni, questions regarding the app continued to be raised regarding its safety, on the issues of anonymization, data sharing and procurement (Iacoboni, 2020). While the Italian DPA clearly stated that Immuni would be fully in line with GDPR (particularly with Article 6 and Article 9), with the Ministry of Health as the data controller collecting only TEK as personal data, questions arose regarding whether Immuni is compliant with Article 22 of GDPR on the "Automated individual decision-making,

including profiling", although the Italian DPA clarified that the exposure notification is an automated, algorithmic decision that requires the methods of human intervention upon request of the user to meet Article 22 of the GDPR (Malgieri, 2020). On November 9, 2020, the Italian DPA clarified that Google and Apple are not joint controllers of data, but only data processors for the Immuni app.[21] Cases of false negatives alerts by the app in the absence of a rapid COVID-19 system in the Italian National Healthcare System have also been raised.

Cost-wise, 1.5 million euros were to be awarded for the developer of the app, but Bending Spoons took on the project for free (Fubini and Pennisi, 2020), granting the Italian government a perpetual and irrevocable license of the Immuni app until October 13, 2020.[22] Immuni was released via Google Play and Apple App Store initially, and later also on Huawei App Gallery (Marino, 2021).

5.1.4 Germany – Policy Reversals and the Corona-Warn App (June 15, 2020)

Germany had originally envisioned an app design that would hold personal data on a central server, developed for the Robert Koch Institut (RKI), which serves as the country's COVID-19 response center (Busvine and Rinke, 2020). Having advocated for the PEPP-PT developed by the Fraunhofer Heinrich Hertz Institute[23] at the EU level, Germany's original plan was to centrally store anonymized data but to ensure data protection and security. With hindsight, the fundamental traits of Germany's home-grown, original centralized tracking plan would have been akin to South Korea's SMS, had it operated on a separate system with RKI as the data controller, rather than an app as a platform for exposure notification. Because data privacy is a major issue amongst the German public, centralized database operation did not garner much public support (DW News, 2020). However, Germany's ideas for a centralized app design were squared away when Apple refused to alter its API in development with Google, arguing that it would not let Bluetooth monitoring by an app running in the background. In the stage prior to the app launches, Germany, France, Italy and the UK were in favor of the centralized approach, but the centralized option would have been met with huge public backlash on surveillance and would not have been compatible with Google and Apple's decisions. Germany, as the prime leadership role in the EU, faced challenges to defend GDPR at the utmost of its abilities, while also having to grapple with the COVID-19 situation by adopting digital technology.

When Germany made a U-turn on its policy and decided to adopt the Google-Apple API based on a limited version of Bluetooth technology, Germany's decision had weighed in on data privacy over the adoption of a more effective tracking system for public health safety. Little was anticipated at that point that the COVID-19 situation would exacerbate and be lengthened beyond expectation, causing unrest, protest, and economic downturn from further lockdowns. If there was a goal that Germany accomplished in the process of launching its app, it was indeed upholding the GDPR. Germany's 'Corona Warn App,' launched on June 15, 2020 (Reintjes, 2020),[24][25] carried the legal basis of the processing of personal data in relation to app – the data subjects' consent pursuant to Article 6(1)(a) and Article 9(2)(a) of the GDPR. Unfortunately, the Corona-

[21] "Le risposte date dal Dipartimento alle domande di Report sull'app Immuni," Ministro per l'Innovazione Tecnologica e la Digitalizzazione, November 9, 2020. https://innovazione.gov.it/app-immuni-risposte-report-dipartimento/
[22] "FAQ: Is Immuni operated by the government?" Immuni. https://www.immuni.italia.it/faq.html
[23] "Privacy Protecting Proximity Tracing to fight Corona," Fraunhofer Heinrich Hertz Institute, April 1, 2020. https://www.hhi.fraunhofer.de/en/press-media/news/2020/privacy-protecting-proximity-tracing-to-fight-corona.html
[24] 'Die Corona-Warn-App,' Die Bundesregierung. https://www.bundesregierung.de/breg-de/themen/corona-warn-app
[25] 'Infektionsketten digital unterbrechen mit der Corona-Warn-App,' Robert Koch Institut. https://www.rki.de/DE/Content/InfAZ/N/Neuartiges_Coronavirus/WarnApp/Warn_App.html

Warn-App did not reap success in timely tracking of the viruses, and the process toward the adoption of a digital tool prevented the early adoption of technology for COVID-19 tracking in Germany. Only from the end of 2020, the South Korean model began to shed some light upon the value of conditionally collected and shared data for pandemic governance (zur Nedden, 2020).

Regarding cost, the German government outsourced the app development to Deutsch Telekom and SAP, spending 20 million euros to procure the app (Böhmer et al., 2020).

5.1.5 France – StopCovid App (June 3, 2020) and TousAntiCovid App (October 22, 2020)

For France, standing by the GDPR was equally important as it is one of the biggest influencers in the EU. With backing from the financial ministers of the EU,[26] France had another ongoing battle: the debate on digital taxation against U.S. tech firms such as Google, Apple, Facebook and Amazon. On March 6, 2019, the French government proposed a 3% levy on revenues generated by certain tech companies providing certain digital services to French users, called the Digital Services Tax (DST). Following the approval of the proposed bill by the joint committee of the two houses of the French parliament on June 26, 2019 and the passing of the bill in the French National Assembly on July 4, 2019, the French Senate took up the bill on July 11, 2019 and the law was officially published on July 25, 2019.[27] The Trump administration immediately took retaliatory measures, with the U.S. Trade Representative (USTR) launching a Section 301 investigation under the Trade Act of 1974. After a year of investigations, the U.S. determined on July 16, 2020 an additional 25% tariffs on French exports (i.e., wine and cosmetics) to the U.S. for 180 days.[28] Although these tariffs were suspended by the USTR[29] in the expectation that the newly inaugurated Biden Administration with the intent to ameliorate transatlantic ties, the digital conflict between the EU and the U.S. has only just begun, and clearly served as an underlying catalyst to the French decision to reject the Google-Apple API.

As in the case of Germany, France clashed with Apple from April 2020 in the early process of developing its app, citing that Apple refused to have Bluetooth technology constantly running in the background on iPhones. Apple retained its principle that it is designed to protect users' privacy, and had already begun developing the API in partnership with Google as a prototype for exposure notification (Fouquet, 2020; Hern, 2020). The battle continued on between the French government and Apple as the Section 301 investigations unfolded against the French DST, and in the end, France decided to go it alone without using the Google-Apple API, opting for a centralized app developed by its own agencies but in line with Articles 6 and 9 of GDPR.[30] On June 3, 2020, it first launched its 'StopCovid App,' developed by INRIA (*Institut national de*

[26] "Digital Taxation," European Council, Council of the European Union https://www.consilium.europa.eu/en/policies/digital-taxation/

[27] "LOI n° 2019-759 du 24 juillet 2019 portant création d'une taxe sur les services numériques et modification de la trajectoire de baisse de l'impôt sur les sociétés (1)," Journal officiel de la République Française, July 25, 2019. https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000038811588/

[28] "Section 301-France's Digital Services Tax," Section 301 Investigations, U.S. Trade Representative, July 2019. https://ustr.gov/issue-areas/enforcement/section-301-investigations/section-301-frances-digital-services-tax

[29] "Suspension of Tariff Action in France Digital Services Tax Investigation," U.S. Trade Representative, January 7, 2020. https://ustr.gov/about-us/policy-offices/press-office/press-releases/2021/january/suspension-tariff-action-france-digital-services-tax-investigation

[30] "Regulating Electronic Means to Fight the Spread of COVID-19 - France," Library of Congress, June 2020. https://www.loc.gov/law/help/coronavirus-apps/france.php

recherche en sciences et technologies du numérique),[31] upon receiving a green light from the CNIL (*Commission Nationale de l'Informatique et des Libertés*) on GDPR-compliance, with some reservations.[32][33]

The French public was very unresponsive to the StopCovidApp, and incidents of the app crashing or failing activation on mobile devices were reported. Following deliberation on improving the StopCovidApp, which had been downloaded only 2.6 million times amid surges of COVID-19[34], the French government was prompted to launch another app, called "TousAntiCovid," on October 22, 2020.[35] There were no specific technological improvements in the revised app, and the new app also depended on voluntary downloads.

The estimated cost of development and operation of StopCovid App ranged from 80,000 and 120,000 euros ($91,000-$136,000) a month for expenses related to server-hosting, app development and maintenance work (France 24 with AFP, 2020).

5.1.6 UK – Policy Reversals and the NHS COVID-19 App (September 24, 2020)

The UK has tried to develop its own centralized app since May 5, 2020, but went through a painstaking internal debate and process under the Boris Johnson government (Majeed *et al.*, 2020), until it eventually reversed its decision on June 16, 2020 to follow Germany's path. The UK had originally planned for developing a contact-tracing app under NHSX, a new joint organization for digital, data and technology under the UK government, but when the program was launched in May, the task was delegated to NHS Test and Trace. Following a trial operation on the Isle of Wight, the UK abandoned its indigenous app and instead turned to working with Google and Apple in developing an app based on the Google-Apple API source code.[36]

While the GDPR may not have been the central concern for the UK in the process of Brexit, collecting information of EU citizens residing in the UK and using the app would have been a breach of GDPR, as the GDPR extends beyond the borders of the EU. With the transitional period after the Withdrawal Agreement between the UK and the EU ending on December 31, 2020, the UK and the EU entered into a data protection agreement, under which the transfers of EU citizens' personal data to the United Kingdom would be governed, entitled the EU-UK Trade and Cooperation Agreement (TCA) – which was agreed upon by EU and UK negotiators on December 24, 2020 and went into force on January 1, 2021.[37]

[31] "The StopCovid project, a digital solution to contribute to the citizens' fight against the Covid19 epidemic," INRIA, May 11, 2020. https://www.inria.fr/en/le_projet_stopcovid
[32] "Publication of the CNIL's opinion on the "StopCovid" mobile application project," CNIL, April 30, 2020. https://www.cnil.fr/en/publication-cnils-opinion-stopcovid-mobile-application-project
[33] "Publication of CNIL's opinion on the French "contact tracing" application known as "StopCovid"," CNIL, June 3, 2020. https://www.cnil.fr/en/publication-cnils-opinion-french-contact-tracing-application-known-stopcovid
[34] "Pour un système d'information au service d'une politique cohérente de lutte contre l'épidémie," Comité de Contrôle et de Liaison, Société Civile et Parlement, September 15, 2020. https://solidarites-sante.gouv.fr/IMG/pdf/avis_du_ccl-covid_du_15_09_20._pour_un_systeme_d_information_au_service_d_une_politique_coherente_de_lutte_contre_l_epidemie.pdf
[35] "TousAntiCovid App," Le Gouvernement Français. https://www.gouvernement.fr/info-coronavirus/tousanticovid
[36] Andrea Downey, 'Government abandons contact-tracing app for Apple and Google's tech,' Digital Health, June 18, 2020. https://www.digitalhealth.net/2020/06/government-abandons-contact-tracing-app-for-apple-and-googles-tech/
[37] The European Commission, 'Brexit – Data protection – International dimension of data protection'. https://ec.europa.eu/info/law/law-topic/data-protection/international-dimension-data-protection/brexit_en

The cost for the final version of the NHS contact-tracing app was approximately £25 million, with an additional £10 million that was spent when the UK tried to develop its own model before turning to the Google-Apple API-based app.[38]

5.1.7 United States – Different Apps at State Levels

The U.S. has yet to announce any apps at the federal level, while tech firm Microsoft has offered the 'Bing COVID-19 tracker' on its PowerBI platform. Upon the Google-Apple API launch enabling public health officials to conduct digital contact tracing via smartphone apps (Etherington, 2020a) – a joint contact tracing tool based on Bluetooth, upon which developers hired by governments and public health agencies could develop COVID-19 apps – the technology has become the major prototype for the exposure notification apps currently rolled out throughout the U.S. in more than 20 states and U.S. territories: AL, AZ, CA, CO, CT, DE, DC, HI, MD, MI, MN, NV, NJ, NY, NC, OR, PA, SC, ND & WY, VA, WA and WI, as well as U.S. territories Guam and Puerto Rico. Notably, the first app to be launched was the 'Covidwise app' in the state of Virginia (VA) in August 2020, four months after the Google-Apple partnership on API was announced. Meanwhile, for the 'CA Notify app' in the state of California (CA) where Silicon Valley is located, pilot regions were run before expanding app use statewide on December 10, 2020 (Etherington, 2020b). GPS data collection was allowed in some states, notably in the case of Rhode Island (RI), where the 'Crush COVID RI app' was launched utilizing GPS data.[39]

In the U.S., there are currently no specific regulations in place at the federal level regarding data protection using the COVID-19 apps. Nor are there any obligation for the apps to abide by GDPR *per se*, but states vary on whether GPS data is collected, with some apps based on the Google-Apple API collecting only TEKs and some others collecting GPS data. Just as the EU member states were starting to roll out their COVID-19 apps, lawmakers at the U.S. Senate introduced a bipartisan bill on June 1, 2020, to establish privacy requirements for COVID-19 notification apps. Entitled, 'Exposure Notification Privacy Act,' the bill proposed to establish requirements (i.e., voluntary consent for enrollment in the tracking services and procedures for data privacy purposes) for operators of services, or data controllers of COVID-19 apps at different U.S. states.[40] Although the bill was not passed, such legislation efforts to no avail indicate that the U.S. is internally divided on specific measures in data governance, and that domestic discourse may be different from its foreign economic agenda – as the U.S. has actively pushed for free flow of data and transfer of data in digital trade embedded in its international trade negotiations and agreements, such as the United States-Mexico-Canada Agreement (USMCA), which went into effect on July 1, 2020.[41]

[38] Andrea Downey, 'Total cost of NHS contact-tracing app set to top £35 million,' Digital Health, September 22, 2020. https://www.digitalhealth.net/2020/09/total-cost-of-nhs-contact-tracing-app-set-to-top-35-million/
[39] 'Crush COVID RI,' Rhode Island Department of Health. https://covid.ri.gov/covid-19-prevention/crush-covid-ri
[40] 'S.3861 - Exposure Notification Privacy Act,'116th Congress (2019-2020). June 1, 2020. https://www.congress.gov/bill/116th-congress/senate-bill/3861
[41] 'UNITED STATES–MEXICO–CANADA TRADE FACT SHEET Modernizing NAFTA into a 21st Century Trade Agreement,' the U.S. Trade Representative. Available at: https://ustr.gov/trade-agreements/free-trade-agreements/united-states-mexico-canada-agreement/fact-sheets/modernizing

Table 2 – A Comparison of the Legal Texts on Conditional Data Collection in a Public Health Emergency

South Korea	Infectious Disease Control and Prevention Act (IDCPA)	Personal Information Protection Act (PIPA)
	As revised post-MERS (2015) and revised during COVID-19 (March 2020). Promulgation of the enforcement decree of the IDPCA was passed by the National Assembly on February 26, 2020.[42] [Pre-MERS] -Article 2(1): The term "infectious disease" means any infectious disease classified in Class 1 infectious diseases, Class 2 infectious diseases, Class 3 infectious diseases, Class 4 infectious diseases, parasitic diseases, infectious diseases under surveillance by the World Health Organization, infectious diseases spread through bioterrorism, sexually transmitted infectious diseases, zoonoses, and nosocomial infectious diseases; [Post-MERS] -Article 76-2(1): Equips the Minister of Health and Welfare extensive legal authority to collect private data without warrant from confirmed and potential patients; expressly mandates that private telecommunications companies and the National Police Agency share such data with health authorities at their request. -Article 76-2(2): Enables the health minister and the KDCA head to require "medical institutions, pharmacies, corporations, organizations, and individuals" to provide "information concerning patients...and persons feared to be infected." -Article 6 and 34-2: Invokes the public's right to know and requires the Minister of Health and Welfare to "promptly disclose information" regarding the spread of virus to the public. -Article 47(1): Empowers authorities to shut down any location "deemed contaminated". [During COVID-19] -Article 6: Stipulates that all citizens have a "right to receive the diagnosis and medical treatment of any infectious disease" and the "State and local governments shall bear expenses incurred within." -Article 22-2 (Information Excluded from Disclosure in Case of Infectious Disease Crisis) ① "Information prescribed by Presidential Decree" in Article 34-2 (1) of the Act means the following information. 1. full name 2. Residential address in Eup/Myeon/Dong units or less 3. Other information determined by the Commissioner of the Korea Centers for Disease Control and Prevention to be irrelevant to the prevention of infectious diseases in consideration of the characteristics of each infectious disease. ② When the Commissioner of the Korea Centers for Disease Control and Prevention has determined information not related to the prevention of infectious diseases pursuant to paragraph (1) 3, he/she shall publish the information on the Internet homepage of the Korea Centers for Disease Control and Prevention and notify the Mayor/Do Governor and the head of a Si/Gun/Gu. *Medical Services Act (MDA) -Article 13(2): Empowers the MFDS to allow for testing of infectious diseases under the IDPCA based on Article 46(2)	Article 18 (Limitation to Out-of-Purpose Use and Provision of Personal Information) (1) A personal information controller shall not use personal information beyond the scope provided for in Articles 15 (1) and 39-3 (1) and (2) or provide it to any third party beyond the scope provided for in Article 17 (1) and (3). <Amended by Act No. 16930, Feb. 4, 2020> (2) Notwithstanding paragraph (1), where any of the following subparagraphs applies, a personal information controller may use personal information or provide it to a third party for other purposes, unless doing so is likely to unfairly infringe on the interest of a data subject or third party: Provided, That information and communications service providers (as set forth in Article 2 (1) 3 of the Act on Promotion of Information and Communications Network Utilization and Information Protection, Etc.; hereinafter the same shall apply) processing the personal information of users (as set forth in Article 2 (1) 4 of the Act on Promotion of Information and Communications Network Utilization and Information Protection, Etc.; hereinafter the same shall apply) are only subject to subparagraphs 1 and 2, and subparagraphs 5 through 9 are applicable only to public institutions: <Amended by Act No. 16930, Feb. 4, 2020> 1. Where additional consent is obtained from the data subject; 2. Where special provisions in other laws so require; 3. Where it is deemed manifestly necessary for the protection of life, bodily or property interests of the data subject or third party from imminent danger where the data subject…
European Union	General Data Protection Regulation (2018): Article 6, Lawful Processing	GDPR revision draft (Council of the European Union, 2020)

[42] Enforcement Decree of the Infectious Disease Control and Prevention Act, Presidential Decree No. 29180, September 18, 2020 and amended March 3, 2020. https://elaw.klri.re.kr/kor_service/lawView.do?hseq=49724&lang=ENG

1. [1]Processing shall be lawful only if and to the extent that at least one of the following applies: a) the data subject has given consent to the processing of his or her personal data for one or more specific purposes; b) processing is necessary for the performance of a contract to which the data subject is party or in order to take steps at the request of the data subject prior to entering into a contract; c) processing is necessary for compliance with a legal obligation to which the controller is subject; d) processing is necessary in order to protect the vital interests of the data subject or of another natural person; e) processing is necessary for the performance of a task carried out in the public interest or in the exercise of official authority vested in the controller; f) processing is necessary for the purposes of the legitimate interests pursued by the controller or by a third party, except where such interests are overridden by the interests or fundamental rights and freedoms of the data subject which require protection of personal data, in particular where the data subject is a child. [2]Point (f) of the first subparagraph shall not apply to processing carried out by public authorities in the performance of their tasks.	i. Article 6b (1) (d) – 'vital interest' Including in the light of the COVID-19 pandemic, the Presidency would like to discuss whether provisions on the permission to process electronic communications metadata for the protection of vital interests as set out in the latest compromise text 6543/20 are still supported by Member States, or whether further alignment to the GDPR is needed. The Presidency therefore invites Member States to comment on the following options: Option 1: Article 6b (1) (d) in the latest compromise text 6543/20 is to remain unchanged: '(d) it is necessary to protect the vital interest of a natural person, in the case of emergency, in general upon request of a public authority, in accordance with Union or Member State law; or' (...) Option 2: Article 6b (1) (d) should be aligned on the wording of Article 6 (1) (d) GDPR, and a recital corresponding to Recital 46 GDPR should be included, replacing Recital 17a in the latest compromise text set out in 6543/20: '(d) it is necessary in order to protect the vital interests of the end-user or of another natural person.' New recital: 'The processing of electronic communications metadata should also be regarded as lawful where it is necessary to protect an interest which is essential for the life of the end-user or that of another natural person. Processing of electronic communications metadata for the protection of vital interests of the end-user may include for instance processing necessary for humanitarian purposes, including for monitoring epidemics and their spread or in humanitarian emergencies, in particular natural and man-made disasters.'

Sources: Excerpts of legal texts of the Republic of Korea and the European Union on Data Governance

Infectious Disease Control and Prevention Act, Republic of Korea (*Infectious Disease Control and Prevention Act*, 2020)

Personal Information Protection Act, Republic of Korea (*Personal Information Protection Act*, 2013)

General Data Protection Regulation (*Regulation (EU) 2016/679 (General Data Protection Regulation)*, 2018)

GDPR Revision Draft (Council of the European Union, 2020)

Table 3 – Digital Tracing by South Korea and European Countries in Pandemic Governance

Country or Entity	South Korea	EU	EU Member States			United Kingdom	United States
			Germany	France	Italy		
Discovery of Patient Zero and its origin (if identified)	January 20, 2020 (In Incheon, from Wuhan, China)	NA*	January 20, 2020 (In Munich, from Shanghai, China)	November 16, 2019 (In Colmar, France)	November 10, 2020 (In Milan, Italy)	February 21, 2020 (In Nottinghamshire, England)	January 20, 2020 (In Seattle, from Wuhan, China)
Tracing Software Name and Release Date	COVID-19 Smart Management System (March 26, 2020)	Suggestions on Pan-EU Corona App (April 2020)	Corona Warn App (June 15, 2020)	StopCovid App (June 3, 2020) TousAntiCovid App (October 22, 2020)	Immuni (June 1, 2020)	NHS COVID-19 app (September 24, 2020)	Variation by state
Legal Foundations	IDCPA (Revised 2015) PIPA	GDPR - currently undergoing revision	GDPR (Call for Germany's own Corona App Law)	GDPR French National Law (Reviewed by CNIL)	GDPR Italian Law Article 14 of Legislative Decree (Reviewed by Italian Data Protection Authority)	Subject to GDPR if used on EU citizens	Subject to state laws and launches
GDPR Compliance for COVID tracking	NA*	Regulation (EU) 2016/679 (a.k.a. GDPR)	GDPR Article 6(1)(a) Article 9(2)(a)	GDPR Article 5(1)(b) Article 6	GDPR Article 6 Article 22 (unclear)	Article 6 Article 9 Article 22 (unclear)	NA*
Electronic Tracing Method/ Enforcement	Centralized, Compulsory (IDCPA, PIPA)	Pan-EU Corona App Launch Discussion (April 2020)	Decentralized, Voluntary	Centralized, Voluntary	Decentralized, Voluntary	Decentralized, Voluntary	Decentralized
Data deployed	GPS data Credit Card transactions CCTV footages	NA	No GPS Data	No GPS Data	No GPS Data	No GPS Data	Variation by state
Source Code Provider	Ministry of Land, Infrastructure and Transport (MOLIT)	NA	Apple/Google API (Bluetooth)	Apple/Google API (Bluetooth)	Apple/Google API (Bluetooth)	Apple/Google API (Bluetooth)	Apple/Google API (Bluetooth)
Software or System Developer	MOLIT	NA	Deutsch Telekom, SAP	INRIA, ANSSI, MOSH, Santé Publique France, French tech firms	Bending Spoons	NHS Test and Trace; NHSX, Alan Turing Institute	Variation by state
Downloads as of January 2021	NA	NA	25.2 million	12.3 million	10.2 million	19 million (October 2021)	Variation by state
Population (2019 World Bank, Eurostat figures)			83.2 million	67.06 million	60.3 million	56.29 million (England) and 3.15 million (Wales)	Variation by state

Source: Compiled based on press releases, app listings and official documents of the governments of observation.

Table 3 indicates the relevant articles of the GDPR that have come under scrutiny during the COVID-19 pandemic. The main articles of GDPR at stake in digital tracing of COVID-19 were Article 6 (Lawfulness of processing), Article 9 (Processing of special categories of personal data), and Article 22 (Automated individual decision-making, including profiling).

5 Projections on the AI Strategies for the Contactless Economy in the COVID-19 Era

The path to AI is expedited in the COVID-19 pandemic, at a time when data governance varies across countries. While GPAI – launched by 11 OECD member states in the middle of the pandemic on June 15, 2020 and currently expanded to 19 members – has presented an avenue for discussion by like-minded countries on AI, several challenges lie ahead. At such a critical juncture in which data and AI-driven way of life – a baseline scenario under which the collection and processing of data feeds into the deployment of AI in day-to-day matters – is no longer avoidable given the unending nature of COVID-19, even the like-minded countries of GPAI have revealed their differences and institutional variance in deploying digital technology to fight COVID-19, at a time of grave national emergency and public health crisis. The digital divide amongst the founding members was evidenced by the methods chosen by European states as they pondered upon launching their own apps upon witnessing electronic tracing by Asian economies to flatten the curve.

The contactless environment propelled by the COVID-19 pandemic had clearly broken ice on a long-awaited conversation. The launch in the absence of China came amidst brewing tensions across the Atlantic in the digital realm. Noting that the GPAI was launched at the OECD in the midst of trade wars expanding into tech wars for digital technology and AI, transatlantic data governance debates are likely to expand into the future. The U.S. continues to pressure Europe to block the adoption of Huawei equipment for 5G roll-outs, while at the same time targeting the GDPR, the EU's powerful legal tool equipped with strong punitive measures for global companies in breach of data protection. In its own defense, the EU's moves for digital taxation of U.S. tech firms are catered to lessening the bloc's reliance on digital monopolies.

What appears to be a challenge from this point forward, notably in the 'Democracy 11' (D11) as an expanded form of G7, consisting of the core economies of the global economy that exhibit their weariness of China[43], is the setting of agenda and policy framework for data governance in relevance to AI strategies. It is highly anticipated that global trade dynamics would be reformulated based on how data is handled, to what varying degrees AI would be adopted across countries, whereby businesses will benefit and perish. Trade conflicts will arise mainly centering on data issues, such as cross-border data transfers and the failure to abide by different national laws on data governance. For policy convergence, at least for pandemic governance purposes, recognizing the need for conditional data collection to fight future pandemics could serve as the starting line for like-minded countries.

Table 4 – Institutional Variance of Data Governance and AI Strategies by Countries

Country or Regional Entity	Legal Foundations on Data Governance in Pandemics	AI Strategy Launch Year
South Korea	PIPA, IDCPA	2019
European Union	GDPR	2020
Germany	National laws	2019
France	GDPR	2018
Italy	Articles 6, 9, 22	2018
United Kingdom		2018
United States	No Federal Laws on data protection Free flow of data / Transfer of data in trade agreements	2019

Source: Based on government documents on AI strategy.

6 Conclusion: Striking a Balance between Personal Data Protection and Public Health Safety

[43] 'FACT SHEET: President Biden and G7 Leaders Launch Build Back Better World (B3W) Partnership,' The White House Briefing Room, June 12, 2021. https://www.whitehouse.gov/briefing-room/statements-releases/2021/06/12/fact-sheet-president-biden-and-g7-leaders-launch-build-back-better-world-b3w-partnership/

In an effort to answer the research question on whether conditional data sharing is necessary in a public health crisis, this article has presented a contextual framework of institutional variance in data governance in the tracking of COVID-19 among South Korea, the U.S. and the European democracies of observation. While it is very much anticipated that the question of digitalization itself may be of critical importance to the readership, the bottom line as far as the COVID-19 pandemic governance is concerned, is that every human life is precious, and if technology can help save lives, citizens around the world would benefit from pondering upon whether there is policy space to strike a balance between public health safety and personal data protection. The line of argument that this article pursues would be critical for the future, as AI tools are deployed in developed economies.

The roll-out of COVID-19 apps provide us with an opportunity to ponder upon how data governance would look like in the future: variance, non-convergence, and potential conflict. The contactless economy becomes the norm with COVID-19, and data policies in cyberspace will be at the center of policy discussions, not only limited to the deployment of AI, but also in future trade negotiations on data transfers, control, management and use. Against this backdrop, countries that are resolved to tackle issues such as de-identification technology, anonymization and pseudonymization in order to adopt new technologies but while protecting the individuals from violation of privacy.

In the case of the U.S., despite the digital prowess the country possesses, the fragmentation of policy implementation manifested amongst states – with only about half of its 50 states deploying the Google-Apple API-based tracking of COVID-19 – signals to the difficulties of consolidating a streamlined policy at the federal level. Such variance in data governance and internal policy implementation indicates that domestic policy agenda is not always in line with external postures, as it is very well understood that in U.S. foreign economic policy the push and advocacy for data transfers in international trade agreements have been crucial in its international trade agreements and negotiations.

The varied steps taken on COVID-19 tracing apps in Europe – one of many instances to come in the future as the digital transformation into AI is accelerated in the 'contactless' environment of the pandemic – attest to the foreseen difficulties of policy convergence or cooperation on digital issues. In Europe, where there is strong resistance against the use of personal data by the government or big tech, it has been demonstrated that the efficacy of the tracing apps is not prioritized, but rather lost as GDPR is the precondition for deploying a digital tracking mechanism, even under the circumstances of public health emergency. Noting that Europe's current digital infrastructure and smartphone usage rate in Western Europe that falls short of building a required critical mass for app-based digital tracking to be effective, not only does the current version of GDPR make mobilizing public support for usage of the app difficult, but the nature of voluntary participation under GDPR also hinders European citizens from utilizing tech to fight the virus. Such limitations of European choice depending entirely on voluntary will of the citizens have indeed led to policy failure and have thus sparked a policy debate on the original purpose of the apps, which are intended to close the gap between the speed of analog contact tracing and the unprecedented pace of mutation and reproduction of the virus. If tracking technologies in the case of COVID-19 apps – a digital method that does not necessarily involve machine learning or deep learning – brings about the current level of policy divergence witnessed, it is predictable that machine-learning enabled AI adoption in the future will bring about more social unrest in Europe.

To conclude, the policy discourse on the absolute right of the natural person in the digital realm must be scrutinized. This research has revealed that GPS data in and of itself cannot be completely sacrosanct when fighting a pandemic, by comparatively investigating the role and extent of digital tracing methods and their outcomes. To what extent countries would push for protecting personal data, as well as for social consensus on health emergencies and civil liberties may continue to vary across jurisdictions, and this would impact the blueprints for deploying AI in the future. For future research, further work on the variation of AI and data

governance deployment in COVID-19 vaccination programs in different jurisdictions would be enlightening, in the view that the utility of data collection and processing may increase the efficacy of vaccine roll-outs in an effort for countries to end the COVID-19 pandemic.

June Park, Ph.D, is a political economist and an East Asia Voices Initiative Fellow at George Washington University. She works on trade, energy, and tech conflicts with a broader range of regional focuses not just on the U.S. and East Asia, but also Europe. She studies economic pressures and conflicts, analyzing different policy outcomes based on governance structures. During COVID-19, she has published widely on South Korea's pandemic governance while remotely conducting research from Seoul, South Korea. In the 2021-2022 academic year, she will continue her research as a Fung Global Fellow (Early Career Scholar) at Princeton University and an inaugural Salzburg Global Seminar-Korea Foundation Fellow.

References

Abeler, J. *et al.* (2020) 'COVID-19 Contact Tracing and Data Protection Can Go Together', *JMIR mHealth and uHealth*, 8(4), p. e19359. doi: 10.2196/19359.

Abueg, M. *et al.* (2020) *Modeling the combined effect of digital exposure notification and non-pharmaceutical interventions on the COVID-19 epidemic in Washington state*. preprint. Epidemiology. doi: 10.1101/2020.08.29.20184135.

Almeida, B. de A. *et al.* (2020) 'Personal data usage and privacy considerations in the COVID-19 global pandemic', *Ciência & Saúde Coletiva*, 25(suppl 1), pp. 2487–2492. doi: 10.1590/1413-81232020256.1.11792020.

Altmann, S. *et al.* (2020) 'Acceptability of App-Based Contact Tracing for COVID-19: Cross-Country Survey Study', *JMIR mHealth and uHealth*, 8(8), p. e19857. doi: 10.2196/19857.

Application TousAntiCovid (no date). Available at: https://www.gouvernement.fr/info-coronavirus/tousanticovid.

Arakpogun, E. O. *et al.* (2020) 'Digital contact-tracing and pandemics: Institutional and technological preparedness in Africa', *World Development*, 136, p. 105105. doi: 10.1016/j.worlddev.2020.105105.

Bassi, A. *et al.* (2020) 'An overview of mobile applications (apps) to support the coronavirus disease-2019 response in India', *Indian Journal of Medical Research*, 0(0), p. 0. doi: 10.4103/ijmr.IJMR_1200_20.

Benke, K. and Benke, G. (2018) 'Artificial Intelligence and Big Data in Public Health', *International Journal of Environmental Research and Public Health*, 15(12), p. 2796. doi: 10.3390/ijerph15122796.

Böhmer, M. M. *et al.* (2020) 'Investigation of a COVID-19 outbreak in Germany resulting from a single travel-associated primary case: a case series', *The Lancet Infectious Diseases*, 20(8), pp. 920–928. doi: 10.1016/S1473-3099(20)30314-5.

Bradford, L., Aboy, M. and Liddell, K. (2020) 'COVID-19 contact tracing apps: a stress test for privacy, the GDPR, and data protection regimes', *Journal of Law and the Biosciences*, 7(1), p. lsaa034. doi: 10.1093/jlb/lsaa034.

Brandom, R. (2020) 'Answering the 12 Biggest Questions about Apple and Google's New Coronavirus Tracking Project', *The Verge*, 11 April. Available at: https://www.theverge.com/2020/4/11/21216803/apple-google-coronavirus-tracking-app-covid-bluetooth-secure.

Braun, M. and Hummel, P. (2020) 'Contact-tracing apps: contested answers to ethical questions', *Nature*, 583(7816), pp. 360–360. doi: 10.1038/d41586-020-02084-z.

Bruns, D. P., Kraguljac, N. V. and Bruns, T. R. (2020) 'COVID-19: Facts, Cultural Considerations, and Risk of Stigmatization', *Journal of Transcultural Nursing*, 31(4), pp. 326–332. doi: 10.1177/1043659620917724.

Busvine, D. and Rinke, A. (2020a) 'Germany at odds with Apple on smartphone coronavirus contact tracing', *Reuters*, 23 April. Available at: https://www.reuters.com/article/us-health-coronavirus-europe-tech/germany-at-odds-with-apple-on-smartphone-coronavirus-contact-tracing-idUSKCN2251MR.

Busvine, D. and Rinke, A. (2020b) 'Germany flips to Apple-Google approach on smartphone contact tracing', *Reuters*, 26 April. Available at: https://www.reuters.com/article/us-health-coronavirus-europe-tech/germany-flips-to-apple-google-approach-on-smartphone-contact-tracing-idUSKCN22807J.

Chan, H. (2020) 'Pervasive personal data collection at the heart of South Korea's COVID-19 success may not translate', *Thompson Reuters Blog*, 26 March. Available at: https://blogs.thomsonreuters.com/answerson/south-korea-covid-19-data-privacy/.

Chen, C.-M. *et al.* (2020) 'Containing COVID-19 Among 627,386 Persons in Contact With the Diamond Princess Cruise Ship Passengers Who Disembarked in Taiwan: Big Data Analytics', *Journal of Medical Internet Research*, 22(5), p. e19540. doi: 10.2196/19540.

Chen, W. J. *et al.* (2020) 'Development of a semi-structured, multifaceted, computer-aided questionnaire for outbreak investigation: e-Outbreak Platform', *Biomedical Journal*, p. S2319417020300949. doi: 10.1016/j.bj.2020.06.007.

CISION PR Newswire (2020) 'YouGov survey finds 80% of data-driven businesses claim they have a critical advantage as impact of pandemic continues', 12 November. Available at: https://www.prnewswire.co.uk/news-releases/yougov-survey-finds-80-of-data-driven-businesses-claim-they-have-a-critical-advantage-as-impact-of-pandemic-continues-814089090.html.

Ciucci, M. and Gouardères, F. (2020) *National COVID-19 contact tracing apps*. Briefing: ITRE in Focus PE 652.711. Policy Department for Economic, Scientific and Quality of Life Policies, Directorate-General for Internal Policies, European Parliament.

Clover, J. (2020) 'California's Exposure Notification System Rolling Out on iPhone Thursday', *MacRumors*, 7 December. Available at: https://www.macrumors.com/2020/12/07/california-exposure-notification-system-launching/.

Coghlan, S., Cheong, M. and Coghlan, B. (2020) 'Tracking, tracing, trust: contemplating mitigating the impact of COVID-19 through technological interventions', *Medical Journal of Australia*, 213(2), p. 94. doi: 10.5694/mja2.50680.

Collado-Borrell, R. *et al.* (2020) 'Features and Functionalities of Smartphone Apps Related to COVID-19: Systematic Search in App Stores and Content Analysis', *Journal of Medical Internet Research*, 22(8), p. e20334. doi: 10.2196/20334.

Council of the European Union (2020a) *Proposal for a Regulation of the European Parliament and of the Council concerning the respect for private life and the protection of personal data in electronic communications and repealing Directive 2002/58/EC (Regulation on Privacy and Electronic Communications)*. Presidency discussion paper 9243/20. Brussels. Available at: https://data.consilium.europa.eu/doc/document/ST-9243-2020-INIT/en/pdf.

Council of the European Union (2020b) *Proposal for a Regulation of the European Parliament and of the Council concerning the respect for private life and the protection of personal data in electronic communications and repealing Directive 2002/58/EC (Regulation on Privacy and Electronic Communications)*. Progress report 12891/20. Brussels. Available at: https://data.consilium.europa.eu/doc/document/ST-12891-2020-INIT/en/pdf.

Criddle, C. and Kelion, L. (2020) 'Coronavirus contact-tracing: World split between two types of app', *BBC News*, 7 May. Available at: https://www.bbc.com/news/technology-52355028.

Denley, A., Foulsham, M. and Hitchen, B. (2019) *GDPR: how to achieve and maintain compliance*.

Drozdiak, N., Lee, Y. and De Vynck, G. (2020) 'Contact-Tracing Apps Aren't the Technology Panacea People Hoped', *Bloomberg Businessweek*, 30 June. Available at: https://www.bloomberg.com/news/articles/2020-06-30/why-coronavirus-contact-tracing-apps-aren-t-ending-the-pandemic?utm_campaign=socialflow-organic&cmpid=socialflow-twitter-business&utm_medium=social&utm_content=business&utm_source=twitter.

DW News (2020) 'Germany pivots to decentralized contact tracing app', *Deutsche Welle*, 5 May. Available at: https://www.dw.com/en/germany-pivots-to-decentralized-contact-tracing-app/av-53343220.

DW News (no date) 'Germany launches "best" coronavirus tracing app', *Deutsche Welle*. Available at: https://p.dw.com/p/3dqOb.

Ekong, I., Chukwu, E. and Chukwu, M. (2020) 'COVID-19 Mobile Positioning Data Contact Tracing and Patient Privacy Regulations: Exploratory Search of Global Response Strategies and the Use of Digital Tools in Nigeria', *JMIR mHealth and uHealth*, 8(4), p. e19139. doi: 10.2196/19139.

Etherington, D. (2020a) 'Apple and Google launch exposure notification API, enabling public health authorities to release apps', *TechCrunch*, 21 May. Available at: https://techcrunch.com/2020/05/20/apple-and-google-launch-exposure-notification-api-enabling-public-health-authorities-to-release-apps/?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlLmNvbS8&guce_referrer_sig=AQAAAKgKqhYWPFYLXeSin0r73Ix0L3ZtkZgVc3jPORIe1heJITiVi3X2uM4F_LJElEiaA3qiTDjeRmeUXWwOS4WNyXf3o8d4Zdp32sWiWpl_b9nNERz-3pA6y0tfj6vfdeZL-K1aJ5KNM2mzImn652UJjO9Z8JXsAiE1vPWPNn02rzco.

Etherington, D. (2020b) 'California's CA Notify app to offer statewide exposure notification using Apple and Google's framework', *TechCrunch*, 8 December. Available at: https://techcrunch.com/2020/12/07/californias-ca-notify-app-to-offer-statewide-exposure-notification-using-apple-and-googles-framework/.

EU GDPR & EU-U.S. PRIVACY SHIELD; A POCKET GUIDE, SECOND EDITION (2019). Place of publication not identified: IT GOVERNANCE Publishing.

Europäische Union and Europarat (eds) (2018) *Handbook on European data protection law (2018 Edition)*. 2018 edition. Luxembourg: Publications Office of the European Union (Handbook / FRA, European Union Agency for Fundamental Rights).

European Commission (2019a) *General Data Protection Regulation: one year on*. Press release. European Commission. Available at: https://ec.europa.eu/commission/presscorner/detail/en/IP_19_2610.

European Commission (2019b) *General Data Protection Regulation shows results, but work needs to continue*. Press release. European Commission. Available at: https://ec.europa.eu/commission/presscorner/detail/en/IP_19_4449.

European Parliament (2020) 'P9_TA (2020)0054: EU coordinated action to combat the COVID-19 pandemic and its consequences European Parliament resolution of 17 April 2020 on EU coordinated action to combat the COVID-19 pandemic and its consequences (2020/2616(RSP))'. Available at: https://www.europarl.europa.eu/doceo/document/TA-9-2020-0054_EN.pdf.

Farrell, H. and Newman, A. (2019) *Of Privacy and Power: The Transatlantic Struggle over Freedom and Security*. Princeton, New Jersey: Princeton University Press.

Fateh-Moghadam, P. *et al.* (2020) *Contact tracing during Phase I of the COVID-19 pandemic in the Province of Trento, Italy: key findings and recommendations*. preprint. Epidemiology. doi: 10.1101/2020.07.16.20127357.

Ferretti, L. *et al.* (2020) 'Quantifying SARS-CoV-2 transmission suggests epidemic control with digital contact tracing', *Science*, 368(6491), p. eabb6936. doi: 10.1126/science.abb6936.

Fouquet, H. (2020) 'France Says Apple Bluetooth Policy Is Blocking Virus Tracker', *Bloomberg*, 21 April. Available at: https://www.bloomberg.com/news/articles/2020-04-20/france-says-apple-s-bluetooth-policy-is-blocking-virus-tracker.

France 24 with AFP (2020) 'France's Covid-19 tracing app fails to engage, chalking up roughly 1.5 million users', 23 June. Available at: https://www.france24.com/en/20200623-france-s-covid-19-tracing-app-fails-to-engage-chalking-up-roughly-1-5-million-users.

Fubini, F. and Pennisi, M. (2020) 'Immuni, Luca Ferrari (Bending Spoons): «Per noi nessun guadagno, fiducia e privacy sono fondamentali»', *Corriere Della Sera Tecnologia*, 22 April. Available at: https://www.corriere.it/tecnologia/20_aprile_22/luca-ferrari-bending-spoons-su-immuni-nessun-guadagno-fiducia-privacy-sono-fondamentali-3dc9cf52-84cf-11ea-8d8e-1dff96ef3536.shtml.

Garante per la Protezione dei Dati Personali (2020) 'Coronavirus: No do-it-yourself (DIY) data collection, says the Italian DPA'. Garante per la Protezione dei Dati Personali. Available at: https://www.garanteprivacy.it/web/guest/home/docweb/-/docweb-display/docweb/9282117#1.

Gim, J. *et al.* (2018) *Yureop jeongchiron* (*유럽정치론 = European politics)*. Seoul: Pagyŏngsa.

Giordano, G. *et al.* (2020) 'Modelling the COVID-19 epidemic and implementation of population-wide interventions in Italy', *Nature Medicine*, 26(6), pp. 855–860. doi: 10.1038/s41591-020-0883-7.

Godlee, F. (2020) 'Covid-19: Testing testing', *BMJ*, p. m1918. doi: 10.1136/bmj.m1918.

Google, A. (no date a) *Exposure Notifications: Using technology to help public health authorities fight COVID-19*. Available at: https://www.google.com/covid19/exposurenotifications/.

Google, A. (no date b) *Privacy-Preserving Contact Tracing by Google and Apple*. Available at: https://covid19.apple.com/contacttracing.

Greer, S. *et al.* (2021) *Coronavirus Politics: The Comparative Politics and Policy of COVID-19*. Ann Arbor, MI: University of Michigan Press. doi: 10.3998/mpub.11927713.

Guillon, M. and Kergall, P. (2020) 'Attitudes and opinions on quarantine and support for a contact-tracing application in France during the COVID-19 outbreak', *Public Health*, 188, pp. 21–31. doi: 10.1016/j.puhe.2020.08.026.

Hendl, T., Chung, R. and Wild, V. (2020) 'Pandemic Surveillance and Racialized Subpopulations: Mitigating Vulnerabilities in COVID-19 Apps', *Journal of Bioethical Inquiry*. doi: 10.1007/s11673-020-10034-7.

Hern, A. (2020) 'France urges Apple and Google to ease privacy rules on contact tracing', *The Guardian*, 21 April. Available at: https://www.theguardian.com/world/2020/apr/21/france-apple-google-privacy-contact-tracing-coronavirus.

Iacoboni, J. (2020) 'Is it Safe? The Immuni App Digital Surveillance during the Coronavirus Pandemic', *Byline Times*, 1 May. Available at: https://bylinetimes.com/2020/05/01/is-it-safe-the-immuni-app-digital-surveillance-during-the-coronavirus-pandemic/.

IMD (2020) *IMD World Digital Competitiveness Ranking 2020*. Institute for Management Development. Available at: https://www.imd.org/wcc/world-competitiveness-center-rankings/world-digital-competitiveness-rankings-2020/.

Ince, D. (2019) *A dictionary of the Internet*. Available at: https://www.oxfordreference.com/view/10.1093/acref/9780191884276.001.0001/acref-9780191884276 (Accessed: 10 June 2020).

Infectious Disease Control and Prevention Act (2020). Available at: https://elaw.klri.re.kr/kor_service/lawView.do?hseq=53530&lang=ENG.

Information Commissioner's Office (2019) *Guide to the GDPR*.

Jian, S.-W. *et al.* (2020) 'Contact tracing with digital assistance in Taiwan's COVID-19 outbreak response', *International Journal of Infectious Diseases*, 101, pp. 348–352. doi: 10.1016/j.ijid.2020.09.1483.

Kahn, J. (2020) *Digital contact tracing for pandemic response: ethics and governance guidance*. Baltimore: Johns Hopkins University Press.

Kaspar, K. (2020) 'Motivations for Social Distancing and App Use as Complementary Measures to Combat the COVID-19 Pandemic: Quantitative Survey Study', *Journal of Medical Internet Research*, 22(8), p. e21613. doi: 10.2196/21613.

Kim, H and Korea Artificial Intelligence Association. (2019) *In'gong chinŭng kwa pŏp (Artificial Intelligence and Law = 인공지능과 법)*.

Kim, H.-K. (2020) 'Samsung helps reduce faulty test-kits amid virus outbreak', *Dong-a Ilbo*, 11 June. Available at: https://www.donga.com/en/article/all/20200611/2088320/1/Samsung-helps-reduce-faulty-testing-kits-amid-virus-outbreak.

Kim, M. *et al.* (2020) 'Hi-COVIDNet: Deep Learning Approach to Predict Inbound COVID-19 Patients and Case Study in South Korea', in *Proceedings of the 26th ACM SIGKDD International Conference on Knowledge Discovery & Data Mining*. *KDD '20: The 26th ACM SIGKDD Conference on Knowledge Discovery and Data Mining*, Virtual Event CA USA: ACM, pp. 3466–3473. doi: 10.1145/3394486.3412864.

Kleinman, R. A. and Merkel, C. (2020) 'Digital contact tracing for COVID-19', *Canadian Medical Association Journal*, 192(24), pp. E653–E656. doi: 10.1503/cmaj.200922.

Klenk, M. and Duijf, H. (2020) 'Ethics of digital contact tracing and COVID-19: who is (not) free to go?', *Ethics and Information Technology*. doi: 10.1007/s10676-020-09544-0.

Kretzschmar, M. E. *et al.* (2020) 'Impact of delays on effectiveness of contact tracing strategies for COVID-19: a modelling study', *The Lancet Public Health*, 5(8), pp. e452–e459. doi: 10.1016/S2468-2667(20)30157-2.

KTV YouTube Channel (2020a) *KOREA COVID-19 Smart Management System*. Available at: https://www.youtube.com/watch?v=_sjUtzwDiYQ&t=1s.

KTV YouTube Channel (2020b) *MOLIT & KCDC Online Briefing on COVID-19 Smart Management System (translated)*. Available at: https://www.youtube.com/watch?v=C9o_HGN6v8E.

Lee, D. and Lee, J. (2020) 'Testing on the move: South Korea's rapid response to the COVID-19 pandemic', *Transportation Research Interdisciplinary Perspectives*, 5, p. 100111. doi: 10.1016/j.trip.2020.100111.

Leith, D. J. and Farrell, S. (2020) 'Measurement-based evaluation of Google/Apple Exposure Notification API for proximity detection in a light-rail tram', *PLOS ONE*. Edited by J. Soldani, 15(9), p. e0239943. doi: 10.1371/journal.pone.0239943.

Lenert, L. and McSwain, B. Y. (2020) 'Balancing health privacy, health information exchange, and research in the context of the COVID-19 pandemic', *Journal of the American Medical Informatics Association*, 27(6), pp. 963–966. doi: 10.1093/jamia/ocaa039.

Lomas, N. (2020) 'Europe's PEPP-PT COVID-19 contacts tracing standard push could be squaring up for a fight with Apple and Google', *TechCrunch*, 18 April. Available at: https://techcrunch.com/2020/04/17/europes-pepp-pt-covid-19-contacts-tracing-standard-push-could-be-squaring-up-for-a-fight-with-apple-and-google/.

Lovejoy, B. (2020) 'German contact tracing app using Apple/Google API to launch this week', 15 June. Available at: https://9to5mac.com/2020/06/15/german-contact-tracing-app/.

Lucivero, F. *et al.* (2020) 'COVID-19 and Contact Tracing Apps: Ethical Challenges for a Social Experiment on a Global Scale', *Journal of Bioethical Inquiry*. doi: 10.1007/s11673-020-10016-9.

Majeed, A. *et al.* (2020) 'Can the UK emulate the South Korean approach to covid-19?', *BMJ*, p. m2084. doi: 10.1136/bmj.m2084.

Malgieri, G. (2020) 'The Italian COVID-19 Exposure Alert App: history and legal issues of "Immuni"', *BlogDroitEuropéen*, 17 July. Available at: https://blogdroiteuropeen.com/2020/07/17/the-italian-covid-19-exposure-alert-app-history-and-legal-issues-of-immuni-by-gianclaudio-malgieri/.

Manancourt, V. (2020) 'Coronavirus tests Europe's resolve on privacy', 10 March. Available at: https://www.politico.eu/article/coronavirus-tests-europe-resolve-on-privacy-tracking-apps-germany-italy/.

Mandić-Rajčević, S. *et al.* (2020) *Contact tracing and isolation of asymptomatic spreaders to successfully control the COVID-19 epidemic among healthcare workers in Milan (Italy)*. preprint. Occupational and Environmental Health. doi: 10.1101/2020.05.03.20082818.

Marino, A. (2021) 'Immuni arriva sull'AppGallery di Huawei: Gli smartphone supportati', 30 January. Available at: https://tech.everyeye.it/notizie/immuni-arriva-sull-appgallery-huawei-smartphone-supportati-496261.html.

Martinez-Martin, N. *et al.* (2020) 'Digital Contact Tracing, Privacy, and Public Health', *Hastings Center Report*, 50(3), pp. 43–46. doi: 10.1002/hast.1131.

Ministro per l'innovazione Technologica e la Digitalizzazione (2020) 'Nasce la task force italiana per l'utilizzo dei dati contro l'emergenza Covid-19'. Available at: https://innovazione.gov.it/nasce-la-task-force-italiana-per-l-utilizzo-dei-dati-contro-l-emergenza-covid-19/.

Morley, J. *et al.* (2020) 'Ethical guidelines for COVID-19 tracing apps', *Nature*, 582(7810), pp. 29–31. doi: 10.1038/d41586-020-01578-0.

Nachega, J. B. *et al.* (2020) 'From Easing Lockdowns to Scaling-Up Community-Based COVID-19 Screening, Testing, and Contact Tracing in Africa – Shared Approaches, Innovations, and Challenges to Minimize Morbidity and Mortality', *Clinical Infectious Diseases*, p. ciaa695. doi: 10.1093/cid/ciaa695.

zur Nedden, C. (2020) 'Vorbild Südkorea kämpft plötzlich mit der dritten Welle', *Die Welt*, 10 December. Available at: https://www.welt.de/politik/ausland/plus222186456/Covid-19-Kriegsgebiet-Vorbild-Suedkorea-kaempft-ploetzlich-mit-der-dritten-Welle.html.

Newton, C. (2020) 'Why countries keep bowing to Apple and Google's contact tracing app requirements: They who make the hardware make the rules', *The Verge*, 8 May. Available at: https://www.theverge.com/interface/2020/5/8/21250744/apple-google-contact-tracing-england-germany-exposure-notification-india-privacy.

Nijsingh, N., van Bergen, A. and Wild, V. (2020) 'Applying a Precautionary Approach to Mobile Contact Tracing for COVID-19: The Value of Reversibility', *Journal of Bioethical Inquiry*. doi: 10.1007/s11673-020-10004-z.

Oliver, N. *et al.* (2020) 'Mobile phone data for informing public health actions across the COVID-19 pandemic life cycle', *Science Advances*, 6(23), p. eabc0764. doi: 10.1126/sciadv.abc0764.

Otonomo (2020) *What European Consumers Think about Connected Car Data and Privacy: A Consumer Survey Conducted by Otonomo and SBD Automotive*. Available at: https://f.hubspotusercontent20.net/hubfs/7111373/PDF/OOOO_SBDSurvey.pdf?utm_campaign=asset-sbd-eu-consumer-survey-report&utm_medium=email&_hsmi=92503785&_hsenc=p2ANqtz-_bNBvM7BXCaIzDCB0x-FyUfxl8EFBcjHiLIzo3fjKGcKviQnzhYEUL_DYaBJCzp_UZqB5Z1Q1Ujrqn-_ie3O3t7D1pwQ&utm_content=92503785&utm_source=hs_automation.

OXFORD UNIVERSITY RESEARCH TEAM SUPPORT LAUNCH OF THE NHS COVID-19 CONTACT TRACING APP (2020). Available at: https://www.coronavirus-fraser-group.org/mobile-app.

Park, J, and Chung, E. 2021. "Learning from Past Pandemic Governance: Early Response and Public-Private Partnerships in Testing of COVID-19 in South Korea." *World Development* 137 (January): 105198. https://doi.org/10.1016/j.worlddev.2020.105198.

Park, J. 2021. "Institutions Matter in Fighting COVID-19: Public Health, Social Policies and the Control Tower in South Korea." In Greer, S. L., King, E. J., Massard da Fonseca, E., and Peralta-Santos, A. eds., *Coronavirus Politics: The Comparative Politics and Policy of COVID-19*. University of Michigan Press. https://www.fulcrum.org/concern/monographs/jq085n03q.

Park, June. 2021. "Striking a Balance between Data Privacy and Public Health Safety: A South Korean Perspective, The National Bureau of Asian Research. April 29, 2021." *Commentary from The Evolving Indo-Pacific Trade Environment, The National Bureau of Asian Research*.

Park, S., Choi, G. J. and Ko, H. (2020) 'Information Technology–Based Tracing Strategy in Response to COVID-19 in South Korea—Privacy Controversies', *JAMA*, 323(21), p. 2129. doi: 10.1001/jama.2020.6602.

Parker, M. J. *et al.* (2020) 'Ethics of instantaneous contact tracing using mobile phone apps in the control of the COVID-19 pandemic', *Journal of Medical Ethics*, p. medethics-2020-106314. doi: 10.1136/medethics-2020-106314.

Personal Information Protection Act (2013) *11990*. Available at: https://www.law.go.kr/LSW/lsInfoP.do?lsiSeq=142563&viewCls=engLsInfoR&urlMode=engLsInfoR&chrClsCd=010203#0000.

Peto, J. (2020) 'Covid-19 mass testing facilities could end the epidemic rapidly', *BMJ*, p. m1163. doi: 10.1136/bmj.m1163.

Pollina, E. and Busvine, D. (2020) 'European mobile operators share data for coronavirus fight', *Reuters*, 18 March. Available at: https://www.reuters.com/article/us-health-coronavirus-europe-telecoms/european-mobile-operators-share-data-for-coronavirus-fight-idUSKBN2152C2.

Porta, M. S. *et al.* (eds) (2014) *A dictionary of epidemiology*. Sixth edition. Oxford: Oxford University Press.

'Preserving privacy while addressing COVID-19' (2020) *The Official Microsoft Blog*, 20 April. Available at: https://blogs.microsoft.com/on-the-issues/2020/04/20/privacy-covid-19-data-collection/.

Presidenza del Consiglio dei Ministri (2020) *Immuni: An extra tool to fight the epidemic*. Available at: https://www.immuni.italia.it.

Rahman, M. (2020) 'Here are the countries using Google and Apple's COVID-19 Contact Tracing API', *XDA*, 28 December. Available at: https://www.xda-developers.com/google-apple-covid-19-contact-tracing-exposure-notifications-api-app-list-countries/.

Regulation (EU) 2016/679 (General Data Protection Regulation) (2018). Available at: https://gdpr-info.eu.

Reintjes, R. (2020) 'Lessons in contact tracing from Germany', *BMJ*, p. m2522. doi: 10.1136/bmj.m2522.

Robert Koch Institute, Deutsch Telekom and SAP (no date) *Corona-Warn-App Open Source Project*. Available at: https://www.coronawarn.app/en/.

Rush, D. and de La Bellière, M. (2016) *European Motor Insurance Study: The rise of digitally-enabled motor insurance*. Deloitte. Available at: https://www2.deloitte.com/content/dam/Deloitte/be/Documents/finance/European-Motor-Insurance-Study_2nd-edition_November-2016.pdf.

Sharon, T. (2020) 'Blind-sided by privacy? Digital contact tracing, the Apple/Google API and big tech's newfound role as global health policy makers', *Ethics and Information Technology*. doi: 10.1007/s10676-020-09547-x.

'Show evidence that apps for COVID-19 contact-tracing are secure and effective' (2020) *Nature*, 580(7805), pp. 563–563. doi: 10.1038/d41586-020-01264-1.

Soltani, A., Calo, R. and Bergstrom, C. (2020) *Contact tracing apps are not a solution to the COVID-19 crisis*. Available at: https://www.brookings.edu/techstream/inaccurate-and-insecure-why-contact-tracing-apps-could-be-a-disaster/.

Takeuchi, K. (2020) 'Japan readies for big Olympic crowds with high-tech precautions', *Nikkei Asia*, 2 December. Available at: https://asia.nikkei.com/Spotlight/Tokyo-2020-Olympics/Japan-readies-for-big-Olympic-crowds-with-high-tech-precautions?fbclid=IwAR14C6XVZ3Zl_cvFJOjY--lmR2KTlBWShFXXqBEZMnZZnDzLh_QWmqKpfMw.

Team, I. P. (2017) *EU General Data Protection Regulation (GDPR)*. Ely: IT Governance Ltd. Available at: https://public.ebookcentral.proquest.com/choice/publicfullrecord.aspx?p=5056760 (Accessed: 10 June 2020).

The Washington Post (2020) 'U.S. government, tech industry discussing ways to use smartphone location data to combat coronavirus', 17 March. Available at: https://www.washingtonpost.com/technology/2020/03/17/white-house-location-data-coronavirus/.

Thompson, H. (2020) 'France to release "more interactive" StopCovid app', *The Connexion*, 13 October. Available at: https://www.connexionfrance.com/French-news/France-is-to-release-more-interactive-StopCovid-app-on-October-22.

Timmer, J. (2020) 'Google and Verily clarify their roles in the US coronavirus response', *ArsTechnica*, 16 March. Available at: https://arstechnica.com/science/2020/03/google-contradicts-trump-claims-its-not-working-on-a-coronavirus-portal/.

Um, H. (2020) '[Special Report] Utilizing and Protecting Personal Graphic Imagery Information in the post-COVID-19 era = [특집기획] 포스트 코로나 시대의 개인영상정보 활용과 보호', *Boan News*, 29 July. Available at: https://www.boannews.com/media/news_print.asp?idx=90151.

Vandamme, A.-M. and Nguyen, T. (2020) 'Belgium — concerns about coronavirus contact-tracing apps', *Nature*, 581(7809), pp. 384–384. doi: 10.1038/d41586-020-01552-w.

Vincent, J. (2020) 'Without Apple and Google, the UK's contact-tracing app is in trouble', *The Verge*, 5 May. Available at: https://www.theverge.com/2020/5/5/21248288/uk-covid-19-contact-tracing-app-bluetooth-restrictions-apple-google.

Voigt, P. and von dem Bussche, A. (2017) *The EU General Data Protection Regulation (GDPR)*. Cham: Springer International Publishing. doi: 10.1007/978-3-319-57959-7.

Walensky, R. P. and del Rio, C. (2020) 'From Mitigation to Containment of the COVID-19 Pandemic: Putting the SARS-CoV-2 Genie Back in the Bottle', *JAMA*, 323(19), p. 1889. doi: 10.1001/jama.2020.6572.

Watson, I. *et al.* (2020) 'How this South Korean company created coronavirus test kits in three weeks', *CNN*, 13 March. Available at: https://edition.cnn.com/2020/03/12/asia/coronavirus-south-korea-testing-intl-hnk/index.html.

Wetsman, N. (2020) 'Contact Tracing Apps Promised Big and Didn't Deliver: Emphasizing privacy makes data collection difficult', *The Verge*, 11 December. Available at: https://www.theverge.com/22168473/coronavirus-contact-tracing-apps-exposure-notification-covid-google-apple.

Williams, S. N. *et al.* (2021) 'Public attitudes towards COVID-19 contact tracing apps: A UK-based focus group study', *Health Expectations*, p. hex.13179. doi: 10.1111/hex.13179.

Yap, K. Y.-L. and Xie, Q. (2020) 'Personalizing symptom monitoring and contact tracing efforts through a COVID-19 web-app', *Infectious Diseases of Poverty*, 9(1), p. 93. doi: 10.1186/s40249-020-00711-5.

Yasaka, T. M., Lehrich, B. M. and Sahyouni, R. (2020) 'Peer-to-Peer Contact Tracing: Development of a Privacy-Preserving Smartphone App', *JMIR mHealth and uHealth*, 8(4), p. e18936. doi: 10.2196/18936.

Yoon, J. (2020) Tracking the movement of confirmed patients within 10 minutes…the COVID-19 Smart Management System that grabbed the world's attention = 10 분내 확진자 동선추적…세계가 주목한 코로나 역학조사 시스템)', *Yonhap News*, 10 April. Available at: https://www.yna.co.kr/view/AKR20200410149400003.