GOVERNING COVID-19 THROUGH DIGITAL TECHNOLOGIES: A GLOBAL PERSPECTIVE

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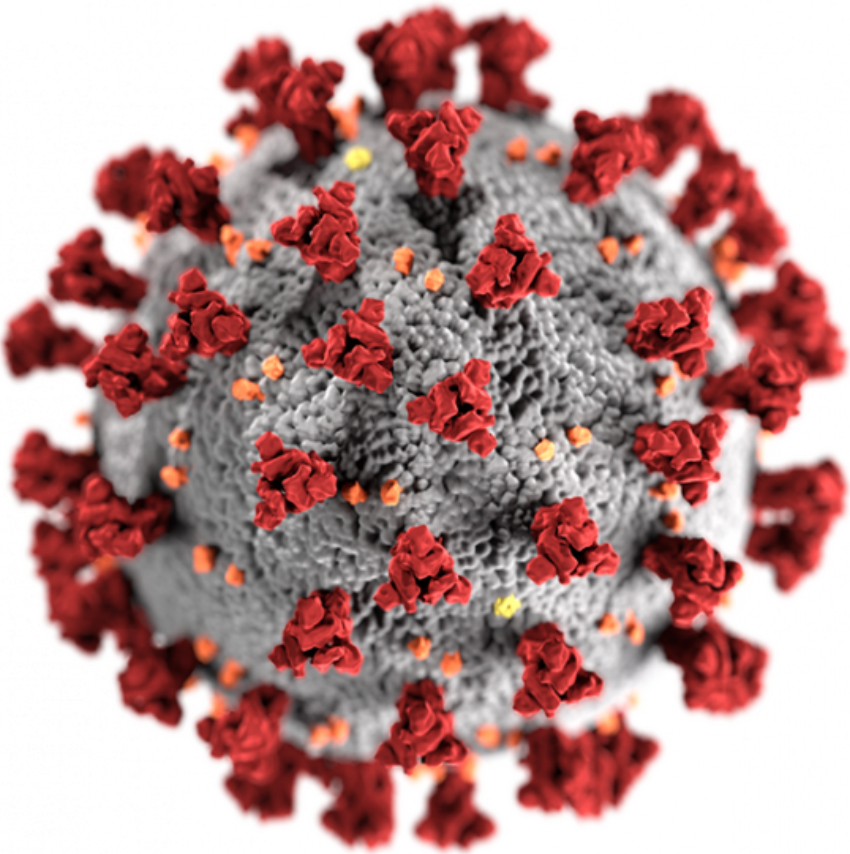

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Introduction

The increasing use of mature digital technologies in governance around the world has allowed governments to create innovative and unprecedented techniques for addressing familiar problems -- for example, the treatment of disease, the tracking of misinformation, and the enforcement of laws to protect the public health. But the Covid-19 pandemic has brought with it an entirely new host of troubling questions about the role of digital technology in state surveillance and management of massive disease outbreaks. The governments of the world vary widely in their familiarity with and access to mature surveillance systems, as well as their intervening pre-commitment strategies for individual rights.

The United States is currently struggling to develop a comprehensive strategy for combating the virus. In this paper, we have endeavored to compile data on the various approaches taken by a set of powerful nations, with a focus on the digital technologies these nations have employed to surveil, treat, police, and inform their populations with respect to the virus. We have examined all of the known tactics available through mature digital technologies, including those which are currently under development. We have also identified several patterns in how these different technologies have been combined into comprehensive strategies for combating Covid-19, as well as their intersections with non-technological methods and relevant human rights critiques. It is our hope that by identifying and examining the choices made by other governments, we will be able to provide some clarity as to the kinds of techniques available to and appropriate for adoption by the United States government.

In Part I, we conduct an overview of all the digital technologies employed throughout the set of nations chosen for this work, and provide an analysis of emerging trends. The nations we have chosen were selected for their significant use of mature digital technologies. We have not included any nation which is not technologically equipped to use digital methods of contact tracing, quarantine enforcement, symptom monitoring and treatment, or information control. Though we recognize that many nations are making substantial efforts to fight the virus without these resources, our purpose here is specifically to examine the digital technologies as part of state efforts to surveil and manage Covid-19.

In Part II, we present three case studies of nations that have successfully slowed the spread of the virus and lowered their death rates since the initial point of infection in their populations. These case studies were selected from within the already narrow set of nations examined in this paper because we found them representative of the three main strategies emerging among this set.

The goal of this paper is not to categorically reject or applaud the use of any one digital technology in a government response to the pandemic. Rather, it is to investigate the means available to a technologically advanced nation and to provide some analysis of those means. It is our hope that this work will be useful in the months or years to come.

The following table provides a summary of our findings for each country and use of digital technologies; Figure 1 provides the annotated version of this table, complete with all sources.

Category	Tactic	China & Hong Kong	South Korea	Israel	Taiwan	Singapore	Russia	UK	Germany	Switzerland
Proximity & Contact Tracing	Telecom Information Sharing	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	To Some Extent
	CCTV Footage Review	Yes	Yes	To Some Extent		Yes	Yes			
	AI Algorithms	Yes		Yes	Yes	Yes	Yes		Under Consideration	
	Mobile Phone Location Surveillance	Yes	Yes	Yes		Yes	In Development	In Development	Yes	Yes
Symptom Monitoring & Healthcare	Use of AI	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Thermal Scanners	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
	Radar Vital Signs Monitoring			Yes						

	Other Monitoring Tools					Yes			Yes	In Development
	Online/Distant Medicine	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Quarantine Enforcement	Telecom Information Sharing	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes
	Mobile Phone Location Surveillance	Yes	Yes	Yes	Yes		Yes	In Development		
	Drone Surveillance / Enforcement	Yes		Yes		Yes	Yes	Not Quite	Under Consideration	
	Digital Passes	Yes	To Some Extent		To Some Extent		Yes	In Development/ Under Consideration	Under Consideration	
	Physical Tracking Devices	Yes	Yes							
	Facial Recognition Technology	Yes	Yes	To Some Extent		To Some Extent	Yes	In Development/ Under Consideration		
Information Control	Information Sharing	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
	Rumor Debunking	Yes			Yes	Yes		Yes	To Some Extent	To Some Extent
	Online Misinformation Surveillance	Yes	Yes		To Some Extent	Yes	Yes	Yes	To Some Extent	To Some Extent
	Dedicated Mobile APPs	Yes	Yes	Yes	Yes	Yes		In Development		Yes

Part 1. Comparative Analysis

Between January and May of 2020, governments around the world employed various digital technologies as part of their efforts to surveil and manage the rapidly spreading Covid-19 pandemic. In Figure 1, we have collected data from the nations selected for our research in an effort to identify which governments are employing which specific technological tactics and for what purposes. All data on this table has been collected from a combination of government websites, the work of journalists, and statements from various international human rights organizations. Because there is no way to know for a fact that a nation's government has *not* considered employing a given tactic, we have chosen to leave cells on the table blank if we could not find data to support a positive indication.

1.1: Government Use of Technology in COVID-19 Response by Country

Figure 1 – Annotated Summary of International Responses Through Digital Technologies

Tactic	China & Hong Kong[1]	South Korea[2]	Israel	Taiwan	Singapore	Russia	UK	Germany[3]	Switzerland
Proximity & Contact Tracing									
Telecom Information Sharing	Yes	Yes	Yes[4]	Yes[5]	Yes[6]	Yes[7]	Yes[8]	Yes	To Some Extent[9]

[1] Please refer to the sources cited in the respective case study below.
[2] Please refer to the sources cited in the respective case study below.
[3] Please refer to the sources cited in the respective case study below.
[4] The emergency regulations authorized the Israeli police to use metadata from telecom companies to enforce Ministry of Health–mandated quarantine, and authorized Shin Bet (Israel's security agency, also known as ISA or Shabak) to use its previously undisclosed cell phone metadata collection to assist with contact tracing. Cahane, Amir. "The Israeli Emergency Regulations for Location Tracking of Coronavirus Carriers." Lawfare, 21 March 2020, The Israeli Emergency Regulations for Location Tracking of Coronavirus Carriers. Accessed 19 April 2020. Cahane's analysis provides a useful, in-depth overview of both emergency regulations. To Track Coronavirus, Israel Moves to Tap Secret Trove of Cellphone Data
[5] Taiwan has shared the locations visited by those who have tested positive with the virus. Tracking the Coronavirus: How Crowded Asian Cities Tackled an Epidemic
[6] Singapore had cultivated a strong government presence in telecommunications well before the pandemic erupted. Link.
[7] Russian telecommunication providers are cooperating with the state to deliver relevant user information. Link.
[8] Similar to Italy, the government has received anonymous data to help monitor the spread but is not using it to conduct individualized contact tracing. Coronavirus: Government using mobile location data to tackle outbreak
[9] The nation's largest mobile operator provided data to the government for the purpose of monitoring crowds and ensuring the public compliance with social distancing orders. Link.

CCTV Footage Review	Yes	Yes	To Some Extent[10]		Yes[11]	Yes[12]			
AI Algorithms	Yes	Yes	Yes[13]	Yes[14]	Yes[15]	Yes[16]		Under Consideration	

[10] Additional tracing efforts include video and audio surveillance in hospitals intended to help minimize medical staff exposure, which has raised privacy concerns Israeli Hospitals Video-Surveil Covid-19 Patients Around the Clock

[11] The Smart Nation initiative, which predates the COVID 19 pandemic, saw the establishment of a network of government cameras across Singapore. Link.

[12] Russia is making use of an extensive, pre-existing network of government cameras. Link.

[13] Public attention has also focused on a potential contact tracing measure proposed by Defense Minister Naftali Bennett to partner with the spyware firm NSO Group. The plan proposes to use artificial intelligence to grade citizens on their likelihood of spreading coronavirus using data collected by the Shin Bet. Scheer, Steven and Cohen, Tova. "Israel to use computer analysis to find likely coronavirus carriers." *Reuters*, 30 March 2020, Israel to use computer analysis to find likely coronavirus carriers. Accessed 19 April 2020. This proposal comes as Bennett calls for the Ministry of Defense and the IDF to be given control of the coronavirus response (Ahronheim, Anna. "Naftali Bennett slams Health Ministry amid coronavirus crisis." *The Jerusalem Post*, 9 April 2020, Naftali Bennett slams Health Ministry amid coronavirus crisis. Accessed 19 April 2020.) and has been met with resistance in the Justice Ministry, which cites legal concerns in providing personal information to a private company and the lack of evidence that this system would be better than the tools that are already available. Landau, Noa and Gontarz, Nir. "'No Tenders in War': Defense Minister Insists on Team-up With NSO to Battle Coronavirus." *Haaretz*, 1 April 2020, Link. Accessed 19 April 2020. NSO Group has also been the subject of hacking and human rights controversies, [NSO is currently under investigation by the FBI on suspicion of hacking, and was sued by WhatsApp in October for allegedly hijacking hundreds of smartphones. Scheer, Steven and Cohen, Tova. "Israel to use computer analysis to find likely coronavirus carriers." *Reuters*, 30 March 2020, Israel to use computer analysis to find likely coronavirus carriers. Accessed 19 April 2020. NSO has also been linked to dissident tracking, including Saudi spying on the murdered journalist Jamal Khashoggi. Kirkpatrick, David D. "Israeli Software Helped Saudis Spy on Khashoggi, Lawsuit Says." *The New York Times*, 2 Dec. 2018, Israeli Software Helped Saudis Spy on Khashoggi, Lawsuit Says. Accessed 19 April 2020.] and concerns have been raised around Bennett's party member Ayelet Shaked's close friendship with NSO's president. Landau, Noa and Gontarz, Nir. "'No Tenders in War': Defense Minister Insists on Team-up With NSO to Battle Coronavirus." *Haaretz*, 1 April 2020, Link. Accessed 19 April 2020. Israel is also using AI-driven contact tracing algorithms to send citizens personalized text messages, instructing them to isolate after being near someone with a positive diagnosis. How governments can build trust in AI while fighting COVID-19

[14] AI Update: Using Artificial Intelligence to Combat COVID-19

[15] Singapore has been steadily increasing its investment into AI systems for healthcare, and these existing systems from the Smart Nation initiative are at the state's disposal for combatting COVID-19: Link.

[16] Link.

Mobile Phone Location Surveillance	Yes	Yes	Yes[17]	[18]	Yes[19]	In Development[20]	In Development[21]	Yes	Yes[22]

[17] The emergency regulations authorized the Israeli police to use metadata from telecom companies to enforce Ministry of Health–mandated quarantine, and authorized Shin Bet (Israel's security agency, also known as ISA or Shabak) to use its previously undisclosed cell phone metadata collection to assist with contact tracing. Cahane, Amir. "The Israeli Emergency Regulations for Location Tracking of Coronavirus Carriers." *Lawfare*, 21 March 2020, The Israeli Emergency Regulations for Location Tracking of Coronavirus Carriers. Accessed 19 April 2020. Nongovernmental organizations challenged the constitutionality of the regulations in *Ben Meir v. Prime Minister*, and on March 19 the Israeli Supreme Court issued an interim decision ordering the police to refrain from exercising power under the regulations and limiting Shin Bet powers. Bandel, Netael. "Israel's top court: No Shin Bet Tracking of Coronavirus Patients Without Knesset Oversight." *Haaretz*, 19 March 2020, Israel's top court: No Shin Bet tracking of coronavirus patients without Knesset oversight. Accessed 18 April 2020. The police regulations were issued as an emergency amendment to the 2007 Israeli Communication Data Law, under which law enforcement authorities may seek data from telecom providers pursuant to a court order. The amendment allows a designated senior officer to obtain location data for carriers of coronavirus as well as those subject to quarantine orders without judicial review. *Lawfare* noted that in forbidding the police from exercising power under the regulations, the Supreme Court's interim order did not declare the powers illegal. Cahane, Amir. "The Israeli Emergency Regulations for Location Tracking of Coronavirus Carriers." *Lawfare*, 21 March 2020, The Israeli Emergency Regulations for Location Tracking of Coronavirus Carriers. Accessed 19 April 2020. Indeed, in subsequent proceedings, the court allowed police surveillance to resume after the state agreed to advance legislation on these enforcement measures. Magid, Jacob. "High Court lets Shin Bet continue phone tracking now Knesset oversight in place." *The Times of Israel*, 25 March 2020, High Court lets Shin Bet continue phone tracking now Knesset oversight in place. Accessed 18 April 2020; Ganon, Tomer. "Israel's Supreme Court Allows Police to Surveil Civilian Phones to Enforce Quarantine Regulations." *CTech*, 25 March 2020, Israel's Supreme Court Allows Police to Surveil Civilian Phones to Enforce Quarantine Regulations. Accessed 18 April 2020. The Shin Bet regulations allow the security service to use online surveillance measures to track the location data and movements of coronavirus carriers in the 14 days prior to their diagnosis, as well as those who were in close contact with them, and to send text messages directing contacts to isolate themselves. Cahane, Amir. "The Israeli Emergency Regulations for Location Tracking of Coronavirus Carriers." *Lawfare*, 21 March 2020, The Israeli Emergency Regulations for Location Tracking of Coronavirus Carriers. Accessed 19 April 2020. The Supreme Court's interim decision limited these powers to track confirmed carriers only, and issued a temporary injunction voiding the regulations until parliamentary oversight committees were formed—which were subsequently created on March 24. Law Library of Congress. *Continuity of Legislative Activities during Emergency Situations in Selected Countries: Israel.* No. 2020-018916. March 2020, Continuity of Legislative Activities during Emergency Situations. Accessed 10 April 2020. On March 31, a Knesset subcommittee approved continued tracking through April 30. "Knesset panel okays controversial phone tracking by Shin Bet to fight virus." *The Times of Israel*, 31 March 2020, Knesset panel okays controversial phone tracking by Shin Bet to fight virus. Accessed 18 April 2020. While the Shin Bet has highlighted the success of its tracking efforts (Gross, Judah Ari. "Shin Bet says it found 500 coronavirus carriers with its mass surveillance." *The Times of Israel*, 26 March 2020, Shin Bet says it found 500 coronavirus carriers with its mass surveillance. Accessed 18 April 2020.) and has emphasized it is not involved in quarantine enforcement, ("Shin Bet denies it will take part in virus quarantine enforcement." *The Times of Israel*, 11 March 2020, Shin Bet denies it will take part in virus quarantine enforcement. Accessed 18 April 2020.) the program remains controversial due to privacy and oversight concerns and for its use of data intended for counterterrorism purposes to track Israel citizens. "Shin Bet denies it will take part in virus quarantine enforcement." *The Times of Israel*, 11 March 2020, Shin Bet denies it will take part in virus quarantine enforcement. Accessed 18 April 2020. The police are also using mobile geolocation services to ensure that the social distancing guidelines are enforced using real time data. Breiner, Josh. "Israeli Police Seek Software to Locate Gatherings, Enforce Coronavirus Lockdown." *Haaretz*, 6 April 2020, Israel police seek software to locate gatherings, enforce coronavirus lockdown. Accessed 19 April 2020. .

[18] Taiwan's robust use of mobile phone location data has been limited to use for quarantine enforcement purposes.

[19] Singapore's TraceTogether app purportedly does not track the user's location, but rather uses bluetooth signals. Link.

[20] The Russian government has expressed a strong interest in employing this technology, but its development has been slow over the last few months. Link. Mobile phone tracking

[22] Switzerland was the first country that launched a contact tracing app using the application programming interface provided by Apple and Google. This technology could alert users who have been in close proximity to infected people without collecting their location data. Link.

Symptom Monitoring & Healthcare									
Use of AI	Yes[23]	Yes	Yes[24]	Yes[25]	Yes[26]	Yes[27]	Yes[28]	Yes	Yes[29]
Thermal Scanners	Yes	Yes	Yes[30]	Yes[31]	Yes[32]	Yes[33]	Yes [34]		
Radar Vital Signs Monitoring			Yes[35]						
Other Monitoring Tool					Yes[36]			Yes	In Development[37]
Online/Distant Medicine	Yes	Yes	Yes[38]	Yes[39]	Yes[40]		Yes[41]	Yes	Yes[42]

[22] Switzerland was the first country that launched a contact tracing app using the application programming interface provided by Apple and Google. This technology could alert users who have been in close proximity to infected people without collecting their location data. Link.

[23] Coronavirus: Chinese supercomputer uses artificial intelligence to diagnose patients from chest scans

[24] Israel is using AI to flag high-risk covid-19 patients; Telemedicine Program at Sheba; Two Israeli hospitals launch AI-based tele-ICU to support COVID-19 patients

[25] Taiwan's Leading-Edge Technologies Help Tackle COVID-19; Response to COVID-19 in Taiwan: Big Data Analytics, New Technology, and Proactive Testing; AI Update: Using Artificial Intelligence to Combat COVID-19

[26] Tapping AI to battle Covid-19, Tech News & Top Stories

[27] Russia created the largest CT scan database in the world to teach AI to diagnose COVID-19 Teaching Artificial Intelligence to diagnose COVID-19

[28] Coronavirus: AI steps up in battle against Covid-19

[29] Hospitals in Switzerland partake in Siemens' project that harnesses the power of AI to better combat COVID-19. AI COVID-19

[30] Israeli company to develop thermal cameras that detect coronavirus

[31] The Secret to Taiwan's Successful COVID Response

[32] The state is allowing some private actors like businesses to use thermal surveillance of their employees through regular heat checks: Link. Additionally, thermal scanners are in use by the state at airports in order to detect and monitor feverish travellers. Link.

[33] Link.

[34] Coronavirus: Portsmouth port installs thermal camera

[35] Ahronheim, Anna. "Radar system protecting Israel's borders will monitor coronavirus patients. *The Jerusalem Post*, 31 March 2020, Radar system protecting Israel's borders will monitor coronavirus patient. Accessed 19 April 2020; Halon, Eytan. "Government tests 4D radar imaging to detect coronavirus symptoms." *The Jerusalem Post*, 16 April 2020, Government tests 4D radar imaging to detect coronavirus symptoms. | Israeli Government Partners With Vayyar to Introduce Life-saving Technology to Combat COVID-19; Israel Adapts Military Radar Systems For COVID-19 Patient Monitoring | News Briefs

[36] The government of Singapore partnered with a startup called KroniKare to pilot the use of a device at St. Andrew's Community Hospital which can detect sweating and facial discoloration in patients in an effort to track their symptoms. Link.

[37] Swiss researchers have developed a novel sensor that could measure the concentration of the virus in the air, such as in places where there are many people or in hospital ventilation systems. Link.

[38] Telemedicine Progam at Sheba; Two Israeli hospitals launch AI-based tele-ICU to support COVID-19 patients

[39] Electronic medicine service was implemented by the Ministry of Health and Welfare for people in isolation. Over 3,000 medical institutions offer telemedicine, including remote diagnosis and treatment. Over 3,000 institutions providing telemedicine for quarantined: NHIA

[40] Doctor Anywhere to launch COVID-19 Medical Advisory Clinic

[41] The NHS has moved quickly to expand use of telemedicine during the pandemic. Telemedecine demand explodes in UK as GPs adapt to coronavirus crisis

[42] Swiss hospitals implemented platforms for tracking symptoms and consulting patients remotely. Link.

Quarantine Enforcement									
Telecom Information Sharing	Yes	Yes	Yes[43]	Yes[44]		Yes[45]	Yes[46]	Yes	Yes[47]
Mobile Phone Location Surveillance	Yes	Yes	Yes[48]	Yes[49]		Yes[50]	In Development[51]		
Drone Surveillance / Enforcement	Yes		Yes[52]		Yes[53]	Yes[54]	Not Quite[55]	Under Consideration [56]	

[43] To Track Coronavirus, Israel Moves to Tap Secret Trove of Cellphone Data
[44] Coronavirus: Under surveillance and confined at home in Taiwan;Policy Decisions and Use of Information Technology to Fight 2019 Novel Coronavirus Disease, Taiwan; Taiwan's new 'electronic fence' for quarantines leads wave of virus monitoring
[45] How Russia is using authoritarian tech to curb coronavirus; Russia to use mobile phones to track people at risk of coronavirus; Contact tracing apps: Russia is different
[46] Coronavirus: Government using mobile location data to tackle outbreak; Watchdog approves use of UK phone data to help fight coronavirus; UK is developing a Bluetooth contact tracing application Everything you need to know about the NHS test, track and trace app
[47] The nation's largest mobile operator provided data to the government for the purpose of monitoring crowds and ensuring the public compliance with social distancing orders. Link.
[48] Please refer to Footnote 19 for a more in depth coverage.
[49] GPS functionality on personal or government-dispatched smartphones are used to ensure that citizens who are quarantined (either preventatively or those with the virus) remain at home.
Policy Decisions and Use of Information Technology to Fight 2019 Novel Coronavirus Disease, Taiwan; Taiwan's new 'electronic fence' for quarantines leads wave of virus monitoring
[50] How Russia is using authoritarian tech to curb coronavirus
[51] Coronavirus: Government using mobile location data to tackle outbreak; Watchdog approves use of UK phone data to help fight coronavirus; UK is developing a Bluetooth contact tracing application Everything you need to know about the NHS test, track and trace app
[52] In terms of quarantine enforcement, Israeli police are using drones to check on patients who have been ordered to self-isolate Krauss, Joseph. "Israeli police use drones to check in on virus patients." *Associated Press*, 14 April 2020, Israeli police use drones to check in on virus patients. Accessed 19 April 2020.
[53] Link.
[54] Link.
[55] There was one report that local police used drones to capture footage of people disobeying lockdown orders, though it was sharply criticized. Coronavirus: Peak District drone police criticised for 'lockdown shaming'
[56] Two largest German police unions have urged authorities to consider allowing the widespread use of drones to help ensure public complication with social distancing rules, but state authorities remain reluctant. Link.

Digital Passes	Yes	To Some Extent		To Some Extent[57]		Yes[58]	In Development/ Under Consideration[59]	Under Consideration [60]	
Physical Tracking Devices	Yes	Yes							
Facial Recognition Technology	Yes	Yes	To Some Extent[61]		To Some Extent[62]	Yes[63]	In Development/ Under Consideration [64]		

[57] Taiwan's Leading-Edge Technologies Help Tackle COVID-19; Response to COVID-19 in Taiwan: Big Data Analytics, New Technology, and Proactive Testing; AI Update: Using Artificial Intelligence to Combat COVID-19

[58] Contact tracing apps: Russia is different

[59] Health Passports being developed to allow those that have already contracted the virus to return to work/life once healthy. Coronavirus UK: health passports 'possible in months' | Politics

[60] There are proposals for German government to issue "immunity certificates" for those who test positive for antibodies to the virus and allow them to leave the country's coronavirus lockdown earlier than the rest of the population. Link.

[61] Israeli anti-terror tech to facially recognize mask-wearing health staff

[62] Though Singapore does have the available tech infrastructure to use facial recognition as a method of quarantine enforcement, the government has apparently required those under quarantine to provide regular photographic evidence of their location. It is unclear whether this is because the government is choosing not to use available camera networks and AI, or if this is an additional measure. Link.

[63] See supra footnote 15.

[64] Health Passports being developed to allow those that have already contracted the virus to return to work/life once healthy. Using facial recognition they could create a digital certificate (immunity passport) Coronavirus UK: health passports 'possible in months' | Politics

Information Control									
Information Sharing	Yes	Yes	Yes[65]	Yes[66]	Yes[67]		Yes[68]	Yes	Yes[69]
Rumor Debunking	Yes			Yes[70]	Yes[71]		Yes [72]	To Some Extent	To Some Extent[73]
Online Misinformation Surveillance	Yes	Yes		To Some Extent[74]	Yes[75]	Yes[76]	Yes[77]	To Some Extent	To Some Extent[78]

[65] The Israeli Ministry of Health has also engaged in a number of public education efforts around the novel coronavirus. The Ministry is sharing up-to-date information via interactive maps demonstrating locations of exposure within the past 14 days ("חשיפה לקורונה." *Ministry of Health*, Link חשיפה לקורונה. Accessed 19 April 2020. Sample entry: "Papa supermarket, Ashdod, 7.4.20, from 14:00 to 14:30.") and locations of home isolations ". קורונה: בידודים פעילים לפי רשות מקומית." *Ministry of Health*, קורונה: בידודים פעילים לפי רשות מקומית. Accessed 19 April 2020. Sample entry: "Number of isolators in Netanya: 173; Population: 213,971; Isolated per 1,000 residents: 0.". In addition, it operates a one-way channel on the cloud-based instant messaging platform Telegram (The channel has approximately 175,000 members as of April 19. Telegram has gained popularity following WhatsApp's ban on bulk and automated messaging. *See e.g.*, Ting, Deanna. "How Bloomberg News is using Telegram." *Digiday*, 10 January 2020, How Bloomberg News is using Telegram. Accessed 19 April 2020.) and developed a chatbot that can be embedded in websites. ". דרכי הטמעה צ'אט בוט משרד הבריאות בנושא קורונה" *Ministry of Health*, הטמעת צ'אט בוט קורונה - משרד הבריאות. Accessed 19 April 2020.

[66] Taiwan CDC upgraded its interactive mobile phone application, Disease-Prevention Butler, and supplemented it with an artificial intelligence chatbot to provide accurate, timely information and gather concerns for analysis and response. Why China's COVID-19 Disinformation Campaign Isn't Working in Taiwan

[67] Link.

[68] The UK government has partnered with WhatsApp to develop a chatbot that lets users subscribe for information about the pandemic and will allow the government to send messages to all users who have opted-in. UK turns to WhatsApp to share coronavirus information

[69] Swiss Federal Office of Public Health publish data on COVID-19 in Switzerland on their website. Link.

[70] CDC set up a dedicated phone line for people to ask questions and report suspicious information; apps provide up-to-date information to counter online rumors. Response to COVID-19 in Taiwan: Big Data Analytics, New Technology, and Proactive Testing

[71] Link.

[72] Coronavirus: Fake news crackdown by UK government

[73] Several Swiss aid groups launched media projects to monitor and debunk rumors around COVID-19. Link.

[74] Although this work seems to be primarily done by groups outside of government, like Taiwan Fact Check Center, there are reports of investigation authorities coordinating with local police stations to stop online sharing of disinformation. Taiwan Fact Check Center has partnered with Facebook so that once posts are identified as disinformation, they are "grayed out" on people's timelines with explanatory footnotes. Why China's COVID-19 Disinformation Campaign Isn't Working in Taiwan

[75] Singapore's "Fake News" laws had already been the source of much debate before the pandemic. Link.

[76] Russia orders tech platforms to remove coronavirus "fake news"

[77] The Cabinet Office set up a special rapid response unit working with social media platforms to remove fake news and the government relaunched a campaign that cautions people to share information carefully online. Coronavirus: Fake news crackdown by UK government

[78] Several Swiss aid groups launched media projects to monitor and debunk rumors around COVID-19. Link.

Dedicated Mobile APPs	Yes	Yes	Yes[79]	Yes[80]	Yes[81]		In Development[82]		Yes[83]

[79] Ministry of Health–endorsed HaMagen ("The Shield") mobile app, a voluntary app that cross-checks GPS history with historical geographic data of patients from the Ministry of Health. Users receive notifications if there is a match and can reject or confirm the notification, the latter of which prompts an option to report the exposure. The Ministry of Health emphasizes that GPS data remains on users' phones and is not shared with third parties, and that the app was created using open-source tools to achieve transparency and to ease collaboration. "HaMagen - The Ministry of Health App for Fighting the Spread of Coronavirus." *Ministry of Health*, Link. As of April 1, around 1.5 million Israelis (17 percent of the population) downloaded the app.Cohen, Tova. "1.5 million Israelis using voluntary coronavirus monitoring app." *Reuters*, 1 April 2020, 1.5 million Israelis using voluntary coronavirus monitoring app. Accessed 18 April 2020. Some have suggested that HaMagen could remove the need for Shin Bet surveillance, particularly given instances of false positives from the Shin Bet. *See e.g.,* Linder, Ronny. "Quarantined After Waving at Coronavirus Patient: How Accurate Is Israel's 'Terrorist-tracking' Tech?" *Haaretz*, 22 March 2020, Link. Accessed 18 April 2020. The Ministry of Health has countered that government surveillance is still necessary for faster contact tracing and to ensure a broad reach. Cohen, Tova. "1.5 million Israelis using voluntary coronavirus monitoring app." *Reuters*, 1 April 2020, 1.5 million Israelis using voluntary coronavirus monitoring app. Accessed 18 April 2020. Human rights expert Professor Yuval Shany of Hebrew University has noted Shin Bet surveillance may be more likely to cover hard-hit ultra-Orthodox communities, where smartphone usage is low. Baker, Stewart A., host. "How Israel is Fighting the Coronavirus." *The Cyberlaw Podcast*, Lawfare, 3 April 2020, The Cyberlaw Podcast: How Israel is Fighting the Coronavirus. In addition, as in countries like China and South Korea, Israel's Ministry of Health has launched a dedicated mobile app, called CoronApp, featuring information including the latest public health guidelines and Ministry announcements; an option to report self-quarantine; locations of exposure; frequently asked questions; and more. "New Health Ministry app is one-stop shop for all things coronavirus. *The Times of Israel*, 5 March 2020, New Health Ministry app is one-stop shop for all things coronavirus. Accessed 19 April 2020; Tercatin, Rosella and Reich, Aaron. "New Israeli apps to make life easier during the coronavirus outbreak." *The Jerusalem Post*, 16 March 2020, New Israeli apps to make life easier during the coronavirus outbreak. Accessed 19 April 2020. CoronApp has more than 100,000 installs on Google Play and is available on the App Store. In early March, CoronApp was reported to have had a security flaw that could expose user data to hackers, though the Ministry of Health responded that the problem was resolved and no personal information had been leaked. Bar-Zik, Ran. "Israeli Government's CoronApp Exposed Users' Medical History to Hackers." *Haaretz*, 10 March 2020, Israeli government's CoronaApp exposed users' medical history to hackers. Accessed 19 April 2020.

[80] Multiple apps have launched in Taiwan, including one that allows people to find stores with masks in stock; another provides information on all those who are COVID-19 positive, where they have been, and their case history. It is unclear whether the latter app is opt-in for those whose records are shared, though Taiwan has integrated all health and travel databases, so perhaps not.
Taiwan's aggressive efforts are paying off in fight against COVID-19

[81] Link.

[82] UK is developing a Bluetooth contact tracing application Everything you need to know about the NHS test, track and trace app

[83] The SwissCovid app, as mentioned above, is dedicated for COVID-19 contact tracing and public education. Link.

1.2: Contact Tracing Tactics by Country[84]

Contact tracing is a vital part of the state's toolkit for combating viral outbreaks. The core idea of the process is to identify all of the people with whom an infected person has had contact during the periods of contraction and possible contagion. This can be accomplished without using much digital technology through interviews with the patient, but the results are significantly more thorough and accurate when the state can make use of tools like telecom information sharing, location tracking technology, AI algorithms, and the footage from a network of CCTV cameras. Some technologically advanced countries have employed such tactics to considerable success. Others abstain from some or all of these tools, citing concerns about the privacy rights of individuals during and after the pandemic. In Figure 2, the set of countries examined in this paper are arranged along a spectrum, from the lightest use of digital technology for proximity and contact tracing to the heaviest. Countries on the lower end of the spectrum may have opted to use manual contact tracing as a substitute for more invasive digital tactics, or may have eliminated much of the need for contact tracing through more severe lockdowns. Countries on the higher end have tapped into and expanded existing systems of digital surveillance technology for this pandemic, to varying degrees of opposition from privacy rights organizations.

Figure 2. Government Use of Technology for Contact Tracing by Country

[84] These diagrams are organized according to the data from **Figure 1** on contact tracing.

The countries in Figure 2 fall into four groups. The first group, in which Taiwan is the sole nation, has the lowest level of digital technology employed in proximity and contact tracing. This does not mean, however, that Taiwan is not using *any* digital technology in its contact tracing. Taiwan's placement is relative to the other nations. In fact, Taiwan has authorized its law enforcement to use mobile phone records to conduct contact tracing and has sent text messages to citizens listing the locations visited by infected persons. The second group, comprising Germany, Switzerland, and the UK, has relied on a blend of lockdown measures and digital technology to mitigate some of the need for contact tracing. The states have received anonymized data from telecommunications companies, but as far as May 2020 that data has only been used to assess population-level compliance with government quarantine mandates rather than to conduct contact tracing. Voluntary contact tracing apps are under consideration or in development in these countries. The third group, comprising Israel and Russia, has utilized digital technology more aggressively in contact tracing. Both nations have a pre-existing national framework of state surveillance equipment, like facial recognition technology and CCTV camera networks, which enabled these countries to transition fairly easily into a high-surveillance contact tracing model. The fourth group of countries, comprising China and Hong Kong, Singapore, and South Korea, are using all technologies identified in the toolkit. Like Group 3 countries, personal data is available to the government and used to conduct contact tracing and monitor the spread of the virus, but without some of the rights safeguards some Group 3 countries have implemented. They have also used personalized data from mobile phones, in some cases without any anonymization.

In Figure 3, the relative use of digital technology for contact tracing among the nations is presented along with a comparison of the relative use of lockdown measures. Though some states are equipped to enforce severe lockdowns and to conduct large scale surveillance, there are states which have chosen only one of those two strategies. Where a country falls on this chart is a function of that country's commitments to public health and individual rights, as well as their national familiarity and comfort with methods of state surveillance. Some countries at very different quadrants of the graph have enjoyed similar success in combating the pandemic.

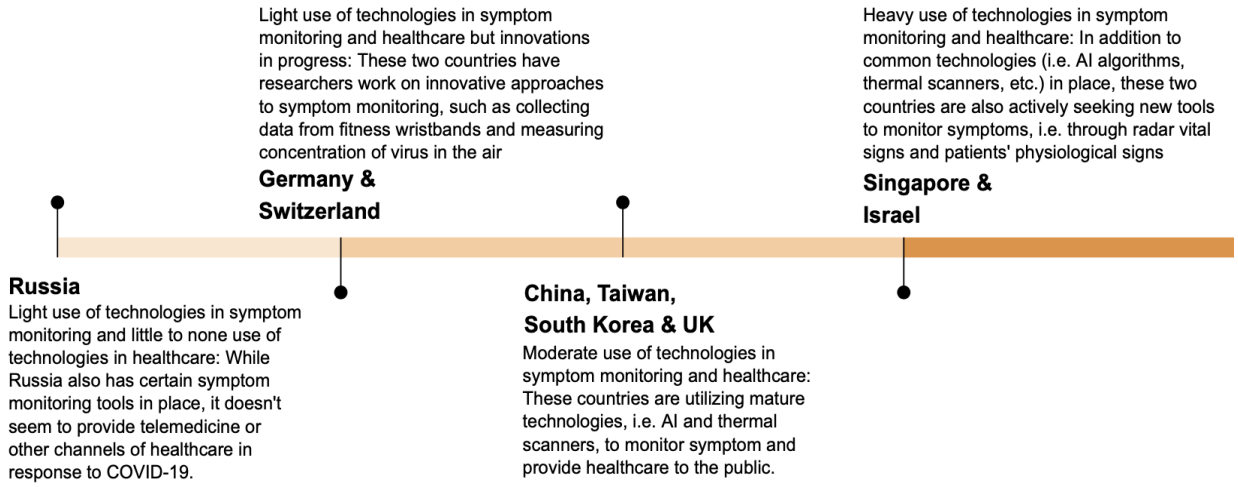
Figure 3. Government Use of Technology for Contact Tracing and Government-Imposed Isolation Measures by Country

Interestingly, countries that fell within the same group in Figure 2 are shown in Figure 3 to have chosen significantly different approaches to government-imposed lockdowns. China and South Korea, for example, both fell into Group 4 in Figure 1. Both nations have the resources, technological experience, and political will to conduct extensive contact tracing through digital technology. And yet, when it comes to the imposition of lockdowns, South Korea has avoided that use of state power. China opted to combine an aggressive contact tracing strategy with the imposition of rigid lockdowns. Both nations have enjoyed considerable success in reducing the spread of the virus through contact tracing.

1.3: Symptom Monitoring & Healthcare by Country

Once a person has contracted the virus, the next phase in which the state can exert influence is symptom monitoring and healthcare techniques. The use of these technologies can increase the effectiveness of treatment while also protecting medical workers. In Figure 4, the nations examined in this paper are arranged on a spectrum, from the lightest use of digital technology in healthcare to the heaviest.

Figure 4. Symptom Monitoring & Healthcare Tactics by Country[85]



Once again, the nations fall into four groups along this spectrum. Russia, alone in the first group, has made the least use of digital technology in healthcare relative to the other nations. Though it has employed some symptom monitoring tools, the nation does not currently provide or endorse a model of telemedicine. The second group, comprising Germany and Switzerland, has taken a slightly more involved approach. These nations have employed more innovative techniques of adapting existing digital technologies for Covid-19 response, including collecting data from fitness wristbands and measuring the concentration of virus in the air. The third group, comprising China and Hong Kong, Taiwan, South Korea, and the UK, are making use of mature technologies like AI and thermal scanners in order to treat and monitor patients. The fourth group, comprising

[85] This diagram is organized according to the data from **Figure 1**, on the countries' overall utilization of technological tools to monitor symptoms of patients and provide healthcare to the public.

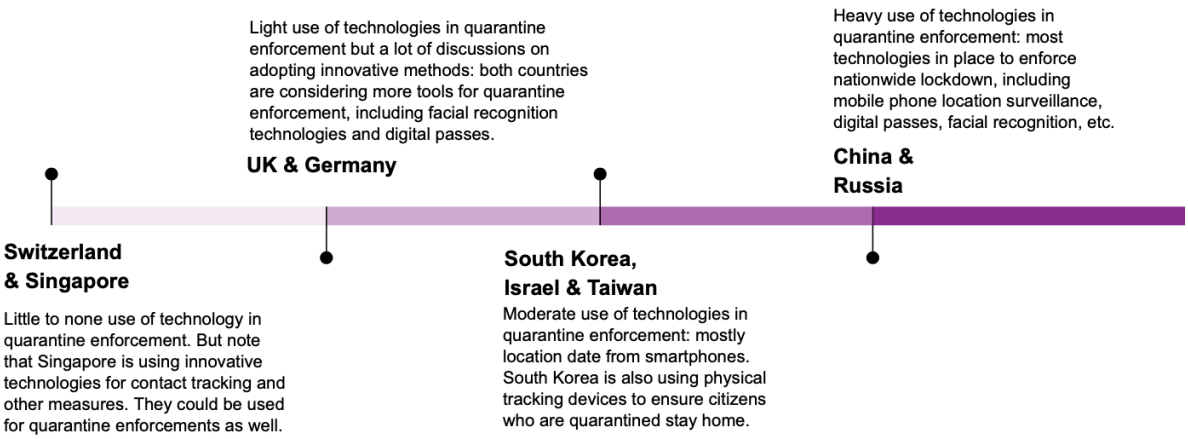
Singapore and Israel, goes even further, seeking new tools like radar vital sign monitors and other physiological monitoring devices for patient care.

1.4: Quarantine Enforcement by Country

When a person tests positive for Covid-19, there is an almost universal consensus that they ought to be temporarily quarantined from the rest of the public, in order to both protect the rights of uninfected persons and limit the danger to the public health generally. While it is theoretically possible to accomplish quarantine enforcement without the use of digital technology, the staggering rates of infection around the world suggest that this is not a feasible tactic for even those nations with robust law enforcement. Thus, many nations have opted to use the same kinds of technology that enable effective contact tracing through surveillance to enforce quarantines.

In Figure 5, the nations examined in this paper are arranged from the lightest use of digital technology in quarantine enforcement to the heaviest. Nations on the higher end of the spectrum tend to have a more robust pre-existing surveillance framework which they then adapted for the pandemic. Nations on the lower end are either highly rights-focused, in that they limit their quarantine enforcement to safeguard individual liberty, or have a highly cooperative citizenry who voluntarily abide by quarantine protocols.

Figure 5. Quarantine Enforcement Tactics by Country[86]

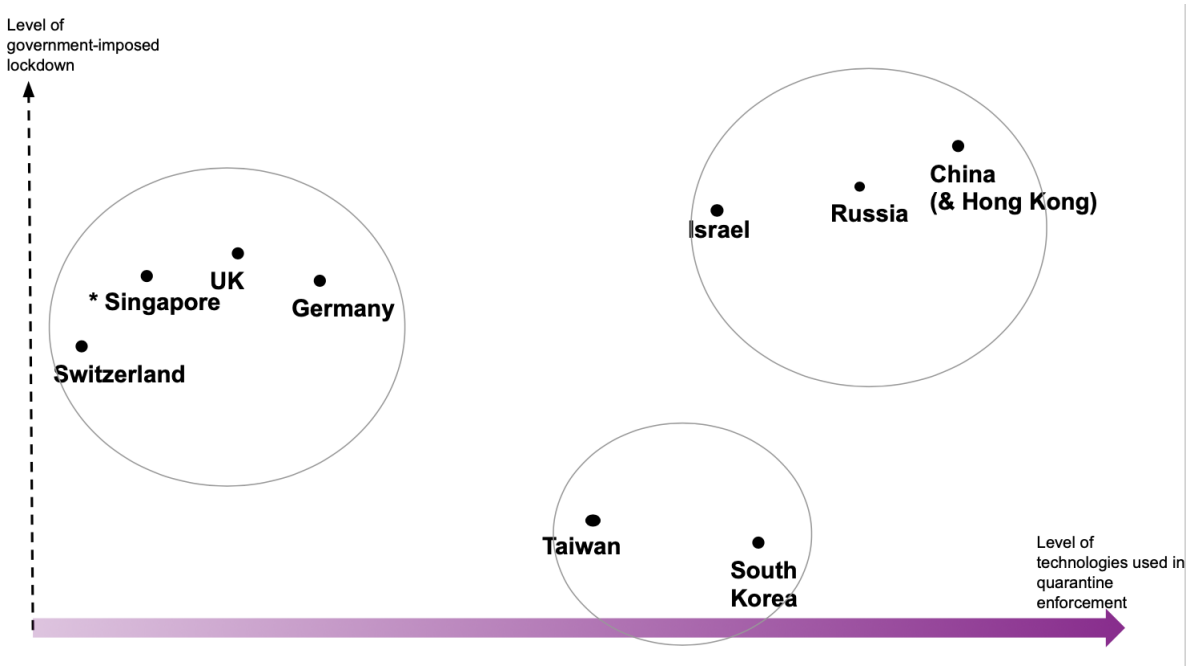


In the first group of nations, comprising Switzerland and Singapore, there is no doubt that the resources exist for more strict quarantine enforcement, yet the government has either chosen not to use them or has not had a strong need to use them. The second group, comprising Germany and the UK, is considering using more of the available quarantine enforcement technologies, including facial recognition software and digital passes. The third group, comprising South Korean, Israel, and Taiwan, have already employed some of these more mature technologies, and are also using location data and physical tracking devices in some cases. The fourth group, comprising China and Hong Kong and Russia, are regularly making use of mature technologies like physical tracking devices and facial recognition -equipped camera networks to enforce quarantines to the utmost degree of strictness.

[86] This diagram is organized according to the data from **Figure 1**, on the countries' overall utilization of technological tools to enforce quarantine orders.

In Figure 6, the relative use of digital technology in quarantine enforcement in these nations is compared with the overall imposition of government lockdowns.

Figure 6. Government-imposed Quarantine and Enforcement Tactics by Country[87]



The nations here cluster into three groups. In South Korea and Taiwan, governments were able to keep the virus spread under control without issuing a total lockdown order, though certain groups of travelers were placed on stricter lockdowns. In China and Hong Kong, Russia, and Israel, governments issued nation-wide quarantine orders; citizens were told not to leave their homes except for a short list of permissible reasons and non-essential businesses were all closed. In the UK, Singapore, Germany, and Switzerland, governments issued some national orders for lockdown, but either uniform citizen compliance or individual rights laws have limited the corresponding use of digital technologies.

[87] The positions of each country on the X-axis of this diagram are organized according to the data from **Figure 1**, on the countries' overall utilization of technological tools to enforce quarantine orders. Their positions on the Y-axis should indicate the latest government orders in regard to quarantine. Sources include: Link; Washington Post: Breaking News, World, US, DC News & Analysis

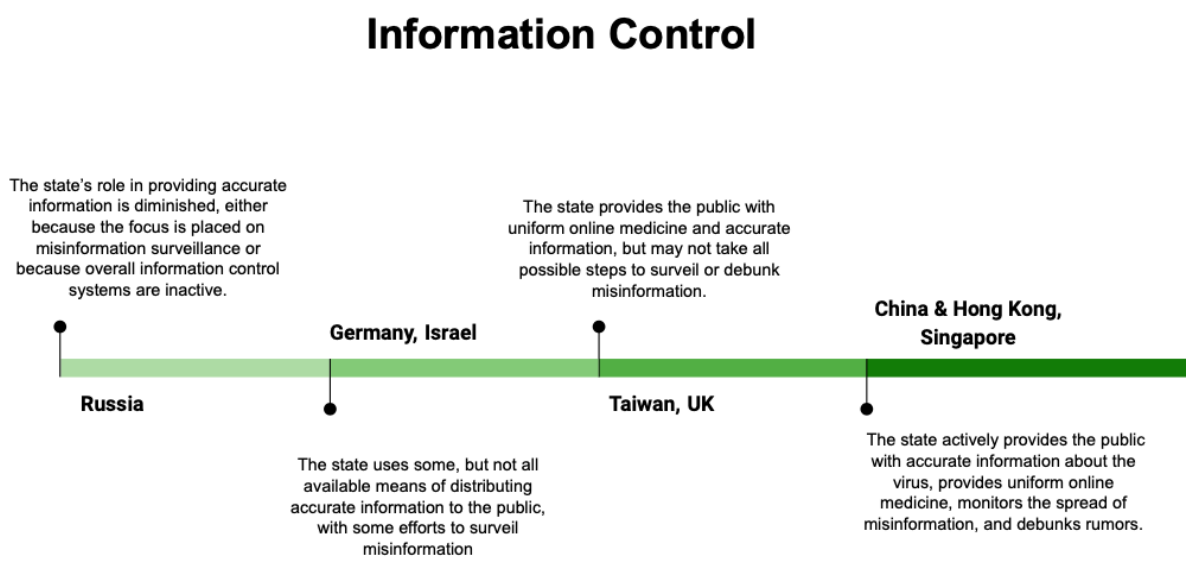
1.5: Information Control by Country[88]

With the pandemic at the forefront of the public consciousness, it is not surprising that the reality of the disease might give rise to a mythology. As scientists frantically work to stop the spread and develop treatments, hoax cures and conspiracy theories have also taken root in every country. Much of this misinformation is harmless error; consider, for example, the somewhat popular misconception that consuming garlic can prevent the contraction of Covid-19. But other pieces of misinformation can be quite harmful indeed, particularly if a person ignores sound medical advice or begins to imagine conspiracies as a result of consuming misinformation. In fact, some false information about the virus actually rises to the level of disinformation -- falsehood spread deliberately in the service of a particular agenda. Governments have the option in this pandemic to either disengage entirely from the policing of false speech, to surveil and punish false speech, or to carve out specific circumstances which activate government intervention in false speech. In addition to these questions about policing falsehood, governments also have to decide whether and to what extent they will engage in the active provision of information about the virus. For our purposes, both of these modes of state involvement fall under the same umbrella of "information control."

In Figure 7, the nations examined in this paper are arranged along a spectrum, from the lightest use of digital technology for information control to the heaviest. Nations on the lower end of the spectrum do not use digital technology for both of the facets of information control, either focusing entirely on the policing of falsehood or else abstaining from the policing of speech with only some introduction of a state-sanctioned ground truth to combat circulating falsehoods. Nations on the higher end actively provide the public with a state-sanctioned ground truth about the virus, and some even surveil all speech looking for misinformation.

[88] These diagrams are organized according to the data from **Figure 1** on information control.

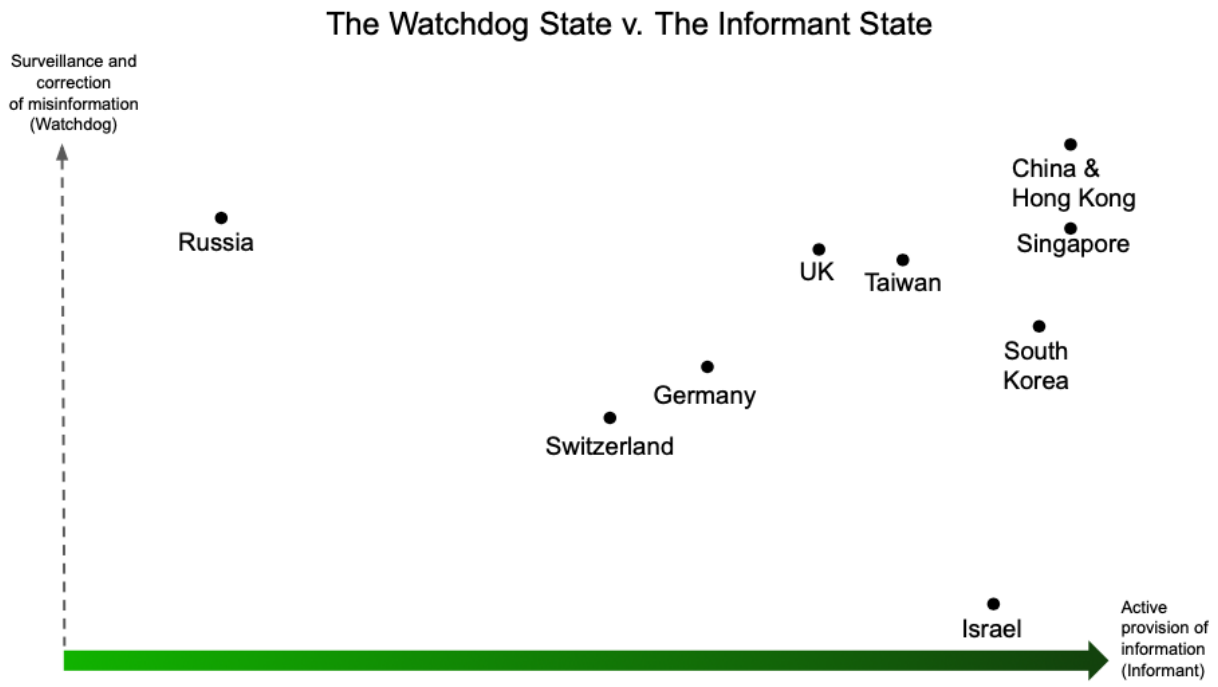
Figure 7. Information Control by Country



Once again, Russia makes up the first group of four. The Russian government does not appear to provide a state-sanctioned ground truth on the virus, though there has been an effort to curtail the spread of misinformation and even some accusations of disinformation levied against other nations. The second group, comprising Germany and Israel, provides the public with some state-approved information on the virus and takes some limited measures to surveil misinformation. The third group, comprising Taiwan and the UK, does not take all possible steps to debunk and surveil misinformation, but these nations do provide the public with uniform online medicine and state-approved pandemic narratives. The fourth group, comprising China and Hong Kong and Singapore, actively surveils misinformation, debunks rumors, and provides the public with a robust state-approved narrative of the virus and its containment.

In Figure 8, the two functions of information control are treated as distinct metrics, and the nations examined in this paper are positioned according to their relative commitments to both strategies. The surveillance of misinformation is referred to as the "Watchdog State" function, while the provision of a state-approved ground truth on the virus is referred to as an "Informant State" function.

Figure 8. The Watchdog State v. The Informant State



This diagram has several limits which ought to be noted. First, the strength of a country's information control measures often poses a challenge for human rights. There is an urgent debate raging as to whether or not a state may justifiably exert force to silence an individual in an effort to prevent the spread of misinformation in a global crisis, and this diagram can't track the nuances of that discourse. Additionally, this diagram does not evaluate the veracity of the information provided by states to their public. While some states are providing objectively accurate information to their people through severe information control and investment in public education on the virus, it is also apparent from the efforts of journalists around the world that some states are using information control methods to convey provably false claims to their populations.

Part 2. Case Studies

2.1: Overview

The nations of the world are all adapting to the pandemic differently, with varying degrees of success in combating the virus' onslaught. We have selected for comparison three nations that have been mostly successful in their efforts to slow the spread of the virus and reduce deaths in their populations. Each of these nations is represented below by a case study, taking into account their preferred uses of digital technology and unique challenges.

The nations selected have been chosen because they are representative of three distinct approaches to confronting the pandemic between January and May of 2020. China was chosen as the representative nation for an aggressive, public health -focused strategy and a high use of digital technology to that end. The Chinese government, along with the Russian and Israeli governments, has come under fire from human rights critics who argue that their robust use of surveillance technology compromises the rights of the individual to their privacy, freedom of speech, and freedom of movement. South Korea's strategy has been equally technological advanced, and yet has evoked significantly less rights-focused criticism. South Korea is the representative nation for countries like Taiwan and Singapore; the citizenry of these nations has generally responded very positively to the public health -focused approach of their governments, even when the tactics these states employ are objectively intrusive. Citizen cooperation and an extensive familiarity with both disease outbreak management and surveillance technology may account for the difference between this category of countries and the first. In the west, Germany and its sister nations in the UK and Switzerland take a much more rights-focused approach than either the first or second categories of countries. The German approach carefully navigates around stringent privacy laws and western legal individualism to manage the pandemic with fewer intrusions into private life.

All three representative nations are technologically advanced and highly equipped to make use of any of the tactics listed in Figure 1 should they so choose.

2.2: People's Republic of China

First detected in China, the coronavirus quickly ballooned into a severe epidemic that ultimately claimed the lives of at least 4,642 people in the country. The virus did so despite a then unprecedented lockdown in Hubei Province, the country's epicenter. Now more than several months have passed since the outbreak first began in China, and the country boasts one of the lowest active case counts of any major country.[89] Experts attribute China's success in controlling the virus to the great reduction of the virus's reproductive number,[90] an effect driven by China's aggressive intervention measures. Among these measures, China marshalled a formidable array of digital technologies to help combat the virus.

Early in the epidemic's development, China's vast public surveillance network[91] turned its eye towards the outbreak. China installed infrared, fever-detecting thermometers in airports, railway stations, long-distance bus stations, and ferry stations across China in mid-January,[92] and telecom companies shared location data of individuals who left Hubei province before the lockdowns began,[93] Theoretically, this allowed authorities to locate and monitor potentially-infected individuals before they had a chance to infect others. Facial-recognition enabled CCTV cameras turbocharged the daunting task of contact tracing,[94] ostensibly with considerable success: CCTV cameras tracked one man's otherwise unexplainable infection to a brief pass-by with an infected stranger that happened 13 days prior.[95] The pandemic panopticon extended online too, as authorities combed the web for false or misleading information and punished those who dared to spread it.[96]

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[89] As of April 20th, China reported an active case count of only 1708 individuals. *See* COVID-19 Global Pandemic Real-time Report. Retrieved April 19, 2020, from Link

[90] Wang, C., Liu, L., Hao, X., Guo, H., Wang, Q., Huang, J., … Wu, T. (2020). Evolving Epidemiology and Impact of Non-pharmaceutical Interventions on the Outbreak of Coronavirus Disease 2019 in Wuhan, China. *MedRxiv*, 2020.03.03.20030593. Link

[91] Mozur, P., & Krolik, A. (2019, December 17). A Surveillance Net Blankets China's Cities, Giving Police Vast Powers. Retrieved April 16, 2020, from Link

[92] World Health Organization. (2020). *Novel Coronavirus (2019-nCov) Situation Report - 21 January 2020*. Retrieved from Link

[93] Yang, Y., Liu, N., & Wong, S.-L. (2020, April 2). China, coronavirus and surveillance: the messy reality of personal data. Retrieved April 16, 2020, from Financial Times website: Link

[94] Heilweil, R. (2020, February 27). Coronavirus is the first test for AI, robots, and drones that can prevent pandemics - Vox. Retrieved April 16, 2020, from Vox News website: Link

[95] 罩买 15 报 诊 动轨 . (2020, February 6). Retrieved April 16, 2020, from 网 website: Link

[96] The intentional creation and spread of false information relating to infectious diseases is prohibited under Article 291-1 of China's Criminal Law. *See* The People's Republic of China Criminal Law. (2017). Retrieved April 17, 2020, from Link. According to China Human Rights Defenders, Chinese authorities punished at least 897 netizens for spreading

While China's surveillance apparatus was being put to task, authorities also leveraged digital technology in an extensive public education campaign. Domestic app developers worked in tandem with many online social media giants as they added dedicated information hubs for the coronavirus to their platforms,[97] including dedicated rumor-bunking pages to combat misinformation.[98] These information hubs played a key role in connecting users to telemedicine services,[99] allowing doctors to safely treat and diagnose patients at a distance. Domestic app developers created "close contact detector" apps that allowed users to check if they had been exposed.[100] Furthermore, building managers hung special QR codes at the entrances of residential compounds throughout China.[101] These QR codes, when scanned, connected users to relevant personal safety information and also allowed users to self-report their health status.[102] This relay of medical information then allowed neighborhood committees[103] to more quickly identify the sick and coordinate food and medicine distribution during the quarantine. Flying drones also soared through the *hutongs*[104] in some cities while trumpeting information like *"Wear your mask! Wash your hands! Stay inside!"*

Finally, digital technology also played a role in enforcing the quarantine measures put in place by Chinese authorities. Phone location data was utilized to enforce curfews,[105]and facial-recognition algorithms were quickly updated to detect both citizens who wore masks and those who did not.[106] Perhaps most indispensable, however, was China's color-coded "Health Code" system,

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coronavirus misinformation online. *See* China: Protect Human Rights While Combating Coronavirus Outbreak | Chinese Human Rights Defenders. (2020, January 31). Retrieved April 19, 2020, from: Link

[97] Grover, D. (2020, April 5). How Chinese Apps Handled Covid-19. Retrieved April 19, 2020, from Dan Grover Blog website: Link

[98] Some social media platforms, like Weibo, are required by law to maintain rumor-debunking mechanisms on their services. *See* 网 办 规 务 应 谣 - 华网. (2018, February 3). Retrieved April 19, 2020, from Link For an example of a rumor-bunking page, *see* COVID-19 Global Pandemic Real-time Report. (Chinese language version). Retrieved April 19, 2020, from Link

[99] Grover, *supra* at 9.

[100] China launches coronavirus "close contact detector" app. (2020). Retrieved April 4, 2020, from BBC News website: Link

[101] Yang, Y., Liu, N., & Wong, S.-L. (2020, April 2). China, coronavirus and surveillance: the messy reality of personal data. Retrieved April 16, 2020, from Financial Times website: Link

[102] *Id.*

[103] Zheng, W. (2020, March 17). Grass-roots officials take lead role on the front line of Wuhan's grid-by-grid battle against coronavirus. Retrieved April 19, 2020, from Link

[104] 'Yes, this drone is speaking to you': How China is reportedly enforcing coronavirus rules | Globalnews.ca. (2020, February 11). Retrieved April 19, 2020, from Global News website: Link

[105] Tidy, J. (2020, April 2). How China's using surveillance to fight coronavirus - BBC News. Retrieved April 5, 2020, from BBC News website: Link

[106] Pollard, M. (2020, March 9). Even mask-wearers can be ID'd, China facial recognition firm says. Retrieved April 19, 2020, from Reuters website: Link

whereby apps like Alipay and Wechat ran user-submitted survey information and personal data through an algorithm to determine whether an individual was at risk of being infected.[107] This data-driven system has played – and continues to play – an important role in safely lifting quarantine measures as China begins to restart her economy.[108]

Overall, China appears to have rapidly employed digital technologies in an uncompromisingly rigorous and coordinated strategy to combat the coronavirus. Digital technologies were employed to a substantial degree in disease surveillance, information control, and quarantine enforcement functions. While personal data and surveillance measures were used in ways that are inconsistent with the privacy rights recognized by other nations, China appears to have enjoyed great success through the implementation of their various policies. China claims one of the lowest fatality rates out of any country, at just over 3 deaths/million people. On April 18th, the country reported only 16 new cases.[109]

2.3: Republic of Korea

The virus was first detected in South Korea on January 20th (coincidentally the same day as the United States).[110] Since then, the nation has had 10,661 cases and 234 deaths (as of April 18th).[111] Despite such an outbreak, South Korea has effectively combated the virus. Since the outbreak first began, 8,042 of the cases have recovered (approximately 75% of its total cases), and its active cases have plummeted from a peak of 7,362 (on March 11, 2020) to 2,484 (on April 18, 2020).[112] Their daily new cases have also plummeted from a peak of 851 (on March 3, 2020) to an impressive low of 18 new cases (on April 18, 2020).[113] What remains more impressive is that the government was able

[107] China's "Health Code" system issued users a QR code in the color of green, yellow, or red. A user's ability to move around the city and between provinces was tied closely to the color of the QR code. *See* Coronavirus: How China's color-coded health system works - Business Insider. (2020). Retrieved April 19, 2020, from Link
[108] *See* China Enforces Smartphone "Health Code" System After Coronavirus | Time. (2020, April 2). Retrieved April 19, 2020, from Associated Press website: Link
[109] 4 18 24时 状 况. (2020, April 18). Retrieved April 19, 2020, from 华 国国 卫 员会 website: Link
[110] Fisher, Max, and Choe Sang-hun. "How South Korea Flattened the Curve." *The New York Times*, The New York Times, 23 Mar. 2020, Link
[111] " South Korea." *Worldometer*, 19 Apr. 2020, Link
[112] " South Korea." *Worldometer*, 19 Apr. 2020, Link
[113] " South Korea." *Worldometer*, 19 Apr. 2020, Link

to control this pandemic without a national lockdown.[114] Given their success, there is much to learn from the strategy deployed by this nation to either implement for the current pandemic in other nations, or in preparation for the next inevitable virus.

In 2015, a South Korean businessman contracted Middle East Respiratory Syndrome (MERS) after returning from a business trip in three Middle Eastern nations.[115] By the time he was diagnosed and isolated, he had already set off a chain of transmission that infected 186 people, and killed 36 individuals.[116] South Korea was forced at the time to test, trace, and quarantine 17,000 people.[117] After serious measures, the virus was defeated after 2 months.[118] In the aftermath of MERS, South Korean officials learned that early government action, testing, and tracing of infected individuals is essential in controlling such outbreaks. Shortly after, the government enacted legislation which gave the government the authority to collect cell phone, credit card, and other data of those individuals who test positive in an outbreak in order to reconstruct their recent whereabouts to identify the chain of transmission.[119]

On January 20th, South Korea had its first official case (the same day as the United States).[120] By the end of that week, government officials met with executives from medical companies to develop mass testing capabilities.[121] Within two weeks, thousands of testing kits were shipped daily (today they produce 100,000 tests daily).[122] Note, it wasn't until late February that kits were distributed by the CDC in the United States.[123] By the near end of February, South Korea had

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[114] Fleming, Sean. "South Korea's Foreign Minister Explains How the Country Contained COVID-19." *World Economic Forum*, 31 Mar. 2020, Link
[115] NormileMar, Dennis, et al. "Coronavirus Cases Have Dropped Sharply in South Korea. What's the Secret to Its Success?" *Science*, American Association for the Advancement of Science, 18 Mar. 2020, Link
[116] NormileMar, Dennis, et al. "Coronavirus Cases Have Dropped Sharply in South Korea. What's the Secret to Its Success?" *Science*, American Association for the Advancement of Science, 18 Mar. 2020, Link
[117] NormileMar, Dennis, et al. "Coronavirus Cases Have Dropped Sharply in South Korea. What's the Secret to Its Success?" *Science*, American Association for the Advancement of Science, 18 Mar. 2020, Link
[118] NormileMar, Dennis, et al. "Coronavirus Cases Have Dropped Sharply in South Korea. What's the Secret to Its Success?" *Science*, American Association for the Advancement of Science, 18 Mar. 2020, Link
[119] NormileMar, Dennis, et al. "Coronavirus Cases Have Dropped Sharply in South Korea. What's the Secret to Its Success?" *Science*, American Association for the Advancement of Science, 18 Mar. 2020, Link
[120] Fisher, Max, and Choe Sang-hun. "How South Korea Flattened the Curve." *The New York Times*, The New York Times, 23 Mar. 2020, Link
[121] Fisher, Max, and Choe Sang-hun. "How South Korea Flattened the Curve." *The New York Times*, The New York Times, 23 Mar. 2020, Link
[122] Fisher, Max, and Choe Sang-hun. "How South Korea Flattened the Curve." *The New York Times*, The New York Times, 23 Mar. 2020, Link
[123] Berger, Matt. "How South Korea Successfully Battled COVID-19 While the U.S. Didn't." *Healthline*, 29 Mar. 2020, Link

tested 94,055 people, meanwhile the United States had tested 3,300 individuals.[124] South Korea was testing at a rate of more than 12,000 people a day by establishing a system of more than 600 new testing sites with over 50 drive-thru testing locations, and delivering results within hours.[125] To put this into perspective, on February 29th, South Korea tested four times more people than the United States had tested in the last month and a half.[126] By March 5th, South Korea had tested 2,845 per million people, whereas the United States (COVID Tracking Project) had tested 3.41 per million people.[127] South Korea was testing heavily before community spread even occurred. By identifying the problem before it spread, the government was able to act within the best window of opportunity to contain the transmission.

The South Korean government has utilized the power of technology to its aid in the battle with COVID-19. Once a patient tests positive with the virus, a rigorous system of contact-tracing is put into play in order to retrace the patient's recent movements so that they can test, and isolate if required, other individuals that the patient may have had contact with.[128] Using GPS data from cell phones and cars, security camera footage, thermal cameras (identifying fevers), credit card purchases, and so on, the government is able to reconstruct the exact whereabouts of a person and identify everyone else they may have been in contact with.[129] Once the other possible patients are traced, they are then tested. If the result is positive, they are quarantined, and the same tracing process starts again with all of the potential people they may have infected.[130] In addition to this rigorous tracing system, the South Korean government has relied on mass messaging to alert the people.[131] When a new patient tests positive, people are alerted with the patient's exact previous whereabouts and description (to the detail of whether or not they were wearing a mask), so that people can identify if

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[124] Hasell, Joe, et al. "To Understand the Global Pandemic, We Need Global Testing – the Our World in Data COVID-19 Testing Dataset." *Our World in Data*, University of Oxford, 31 Mar. 2020, Link
[125] Berger, Matt. "How South Korea Successfully Battled COVID-19 While the U.S. Didn't." *Healthline*, 29 Mar. 2020, Link
[126] Berger, Matt. "How South Korea Successfully Battled COVID-19 While the U.S. Didn't." *Healthline*, 29 Mar. 2020, Link
[127] Hasell, Joe, et al. "To Understand the Global Pandemic, We Need Global Testing – the Our World in Data COVID-19 Testing Dataset." *Our World in Data*, University of Oxford, 31 Mar. 2020, Link
[128] Fisher, Max, and Choe Sang-hun. "How South Korea Flattened the Curve." *The New York Times*, The New York Times, 23 Mar. 2020, Link
[129] Fisher, Max, and Choe Sang-hun. "How South Korea Flattened the Curve." *The New York Times*, The New York Times, 23 Mar. 2020, Link
[130] Fisher, Max, and Choe Sang-hun. "How South Korea Flattened the Curve." *The New York Times*, The New York Times, 23 Mar. 2020, Link
[131] Fisher, Max, and Choe Sang-hun. "How South Korea Flattened the Curve." *The New York Times*, The New York Times, 23 Mar. 2020, Link

they had been in contact with that individual so that they can seek testing as well.[132] In addition, cases are mapped and available to the public so that people are well-informed and aware of nearby cases within their vicinity or areas they may be interested in going to.[133] Individuals that are ordered into a self-quarantine must also download a separate application on their phone.[134] The app tracks their GPS in order to ensure that they have not left their house, and also connects them to COVID-19 caseworkers to whom patients report their condition and progress.[135] [136] A strict fine of $2,500 is even set in place for those who refuse to download the app.[137] The government has further increased their quarantine enforcement by making individuals that have tested positive wear physical tracking devices to ensure that no one leaves their house.[138]

The government is also using different AI-based capabilities to combat the virus.[139] Using AI, the nation was able to create testing within a matter of weeks.[140] Without AI, it was cited that it would have taken 2-3 months to develop.[141] In addition, as a part of its strategy, the nation developed a system which classified patients under 4 different categories: mild, moderate, severe, and very severe.[142] Each category would then receive different treatments and be sent to different facilities based on their level of severity.[143] Doctors then use a variety of different AI-based tools in order to quickly diagnose and classify the patients.[144] Furthermore, the government is also using

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[132] Fisher, Max, and Choe Sang-hun. "How South Korea Flattened the Curve." *The New York Times*, The New York Times, 23 Mar. 2020, Link
[133] Cha, Sangmi. "Mapping Coronavirus: South Koreans Turn to Online Tracking as Cases Surge." *Reuters*, Thomson Reuters, 24 Feb. 2020, Link.
[134] Fisher, Max, and Choe Sang-hun. "How South Korea Flattened the Curve." *The New York Times*, The New York Times, 23 Mar. 2020, Link
[135] Fisher, Max, and Choe Sang-hun. "How South Korea Flattened the Curve." *The New York Times*, The New York Times, 23 Mar. 2020, Link
[136] Yonhap. "S. Korea Adopts Telemedicine to Battle Coronavirus Outbreak." *The Korea Herald*, 13 Mar. 2020, Link.
[137] Fisher, Max, and Choe Sang-hun. "How South Korea Flattened the Curve." *The New York Times*, The New York Times, 23 Mar. 2020, Link
[138] Bostock, Bill. "South Korea Launched Wristbands for Those Breaking Quarantine Because People Were Leaving Their Phones at Home to Trick Government Tracking Apps." *Business Insider*, Business Insider, 11 Apr. 2020, Link
[139] ITU. "COVID-19: How Korea Is Using Innovative Technology and AI to Flatten the Curve." *ITU News*, International Telecommunication Union of the United Nations, 2 Apr. 2020, Link
[140] ITU. "COVID-19: How Korea Is Using Innovative Technology and AI to Flatten the Curve." *ITU News*, International Telecommunication Union of the United Nations, 2 Apr. 2020, Link
[141] ITU. "COVID-19: How Korea Is Using Innovative Technology and AI to Flatten the Curve." *ITU News*, International Telecommunication Union of the United Nations, 2 Apr. 2020, Link
[142] ITU. "COVID-19: How Korea Is Using Innovative Technology and AI to Flatten the Curve." *ITU News*, International Telecommunication Union of the United Nations, 2 Apr. 2020, Link
[143] ITU. "COVID-19: How Korea Is Using Innovative Technology and AI to Flatten the Curve." *ITU News*, International Telecommunication Union of the United Nations, 2 Apr. 2020, Link
[144] ITU. "COVID-19: How Korea Is Using Innovative Technology and AI to Flatten the Curve." *ITU News*, International Telecommunication Union of the United Nations, 2 Apr. 2020, Link

different AI technology to communicate with the public. For instance, there is an AI-based public chat robot that informs people on how to respond to the virus.[145] The government is also using technology to better treat patients. South Korean hospitals have deployed telemedicine platforms in order to limit the contact health officials have with patients, and to provide higher quality healthcare to more remote regions in the nation.[146] Nurses and doctors contact patients through video calls to monitor their situation and to prescribe the appropriate medicine as well.[147] By identifying the chain of transmission, and quarantining those required, the government is essentially surgically removing the virus from society before there is a mass outspread.

In South Korea, by giving consistent pointers on social distancing, detailed information on all the new cases, and constant reminders to wear masks and clean hands, there is a sense of a wartime common goal amongst the population.[148] They understand that they need to play their role, and have done so by staying at home and listening to the orders of their government. Polls in the nation at the moment show majority approval for the government's effort (in stark contrast to the public outcry from the government's delayed response to MERS), panic is low, and hoarding has not become an issue.[149]

South Korea has become a largely undisputed beacon of hope for the rest of the world, as well as a blueprint for how to deal with future pandemics.

2.4: Federal Republic of Germany

Having confirmed its first case in late January 2020, Germany witnessed a rapid escalation of Covid-19 spread in the following two months, as part of the ongoing pandemic across the globe. The Robert Koch Institute (RKI), a federal health agency and research institute, reacted quickly and implemented special measures to minimize the expansion of clusters. By late May, the country was

[145] ITU. "COVID-19: How Korea Is Using Innovative Technology and AI to Flatten the Curve." *ITU News*, International Telecommunication Union of the United Nations, 2 Apr. 2020, Link
[146] Yonhap. "S. Korea Adopts Telemedicine to Battle Coronavirus Outbreak." *The Korea Herald*, 13 Mar. 2020, Link
[147] Yonhap. "S. Korea Adopts Telemedicine to Battle Coronavirus Outbreak." *The Korea Herald*, 13 Mar. 2020, Link
[148] Fisher, Max, and Choe Sang-hun. "How South Korea Flattened the Curve." *The New York Times*, The New York Times, 23 Mar. 2020,Link
[149] Fisher, Max, and Choe Sang-hun. "How South Korea Flattened the Curve." *The New York Times*, The New York Times, 23 Mar. 2020, Link

able to lower the average number of the daily recorded cases to under 500.[150] Its mortality rate has been consistently lower than that of other countries in similar situations.[151] While this result is largely due to the properly funded health system, decisive leadership, and cooperative citizens in Germany, this country also took advantage of its technological edge and utilized a series of digital tools in managing the outbreak.[152]

When it comes to contact tracing, Germany still relies heavily on the traditional method that consists of alerting people who have been in close contact with an infected person, instructing them to self-isolate, and getting them tested periodically.[153] Given the limits of manual contact tracing, the government is exploring ways to automate the contact tracing measures, which are largely restrained by the strict data privacy laws of this country.[154] So far, the government has asked major mobile carriers to share location data, which they have already collected, with health officials in an aggregated and anonymized format.[155] This is allowed under German data privacy rules as it was in the interest of national security.[156] Although individual users are not identified, the data is still useful for the government to identify crowds and potential clusters of the virus.[157] It may provide insights for contact tracing as well as monitoring whether people are complying with quarantine orders.[158]

Germany has also adopted a decentralized solution to collect data to help monitor and alert those who may have contracted Covid-19.[159] The government has developed an app to which a person who tests positive can "donate" their location history.[160] It then anonymizes that data and

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[150] "Germany's contact tracers try to block a second covid-19 wave," *The Economist*, May. 28, 2020. Link.
[151] "How Germany Leveraged Digital Health to Combat Covid-19," *The Medical Futurist*, Apr. 9, 2020. Link.
[152] Jens Spahn, "How Germany contained the coronavirus," *World Economic Forum*, May. 23, 2020. Link.
[153] "Germany's contact tracers try to block a second covid-19 wave," *The Economist*, May. 28, 2020. Link.
[154] "Germany's contact tracers try to block a second covid-19 wave," *The Economist*, May. 28, 2020. Link.
[155] Kelly Servick, "Cellphone tracking could help stem the spread of coronavirus. Is privacy the price?" *Science*, Mar. 22, 2020. Link.
[156] Kelly Servick, "Cellphone tracking could help stem the spread of coronavirus. Is privacy the price?" *Science*, Mar. 22, 2020. Link.
[157] Kelly Servick, "Cellphone tracking could help stem the spread of coronavirus. Is privacy the price?" *Science*, Mar. 22, 2020. Link.
[158] Elvira Pollina and Douglas Busvine, "European mobile operators share data for coronavirus fight," *Reuters*, Mar. 18, 2020. Link.
[159] Kelly Servick, "Cellphone tracking could help stem the spread of coronavirus. Is privacy the price?" *Science*, Mar. 22, 2020. Link.
[160] Kelly Servick, "Cellphone tracking could help stem the spread of coronavirus. Is privacy the price?" *Science*, Mar. 22, 2020. Link.

stores it on its central server.[161] Using a combination of tools, such as GPS tracking, wireless network data, and Bluetooth, the app can detect when a phone comes within a meter of another phone and alert a user who had been in proximity to a confirmed infection without revealing the user's identity.[162] Another app was developed to work with different smartwatches and fitness wristbands.[163] Through this app, the government can collect information about users' activities like walking and exercising; health indicators including blood pressure, heart rate, and temperature; and socio-demographic data such as age, gender, and weight.[164] The data could help understand how infections are spreading and whether containment measures are effective.[165]

While contact tracing technologies have helped Germany better understand and manage the spread of the outbreak, its robust health IT infrastructure could be an important factor of the low fatality rate the country was able to maintain.[166] The government published a list of trusted telemedicine services, most of which are available for free, so that doctors can consult patients safely and remotely.[167] An online chatbot and an online symptom tracker are also available for citizens to self check and for health authorities to screen for suspicious cases.[168] It's worth noting that Germany didn't allow remote health consultation until 2018, but the digital health infrastructures that were built since the restrictions were lifted became a crucial element of the country's solution in managing the pandemic.[169]

Furthermore, an important part of Germany's strategy is clear communication and accurate information. The government was transparent from the beginning of the outbreak and quick to take

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[161] Kelly Servick, "Cellphone tracking could help stem the spread of coronavirus. Is privacy the price?" *Science*, Mar. 22, 2020. Link.
[162] Kelly Servick, "Cellphone tracking could help stem the spread of coronavirus. Is privacy the price?" *Science*, Mar. 22, 2020. Link; Sarah Syed, "Germany Taps SAP, Deutsche Telekom fo Contact Tracing App," *Bloomberg*, Apr. 27, 2020. Link.
[163] Coco Feng, "Germany turns to fitness-tracking app to help monitor coronavirus infections nationwide," South China Morning Post, Apr. 2, 2020. Link.
[164] Coco Feng, "Germany turns to fitness-tracking app to help monitor coronavirus infections nationwide," South China Morning Post, Apr. 2, 2020. Link.
[165] Coco Feng, "Germany turns to fitness-tracking app to help monitor coronavirus infections nationwide," South China Morning Post, Apr. 2, 2020. Link.
[166] "How Germany Leveraged Digital Health to Combat Covid-19," *The Medical Futurist*, Apr. 9, 2020. Link.
[167] Artur Olesch, "Germany benefits from digital health infrastructure during COVID-19 pandemic," *HealthcareITNews,* Mar. 26, 2020. Link.
[168] How Germany Leveraged Digital Health to Combat Covid-19," *The Medical Futurist*, Apr. 9, 2020. Link.
[169] How Germany Leveraged Digital Health to Combat Covid-19," *The Medical Futurist*, Apr. 9, 2020. Link.

strict measures.[170] It was one of the first countries to develop and produce a reliable Covid-19 test.[171] A few government websites update daily and share information regarding the development of Covid-19 in Germany, including a dashboard made by the RKI that maps out the contact tracing findings.[172] Non-government entities also joined efforts to debunk misinformation. For example, Correctiv, a German nonprofit investigative journalism newsroom, created an online portal for the public to submit examples of possible misinformation so the team could run fact-checks and debunk rumors.[173]

Overall, Germany has employed various digital technologies in contact tracing, public health, and information control. Within the limits imposed by the nation's strict data privacy protections, those tools constitute an important element of its Covid-19 response.

Conclusion

Of the wide array of digital technologies available to a technologically advanced government seeking to combat Covid-19, the choice of which tools to use is a function of that nation's general perspective on using digital technology for state purposes. Some nations have already embraced incredibly thorough state surveillance frameworks in the name of safeguarding public health; others abstain from using such powerful devices out of a reluctance to violate the rights of the individual to move anonymously and speak freely. Some governments employ digital technology as a means to provide healthcare and information, while also using their toolkit as the machinery of law enforcement. We do not reject or embrace any particular technology categorically. But it is important for any technologically advanced nation to know its options and to develop a consistent and comprehensive strategy incorporating those tools it chooses. By collecting data from technologically advanced nations across the world and identifying the strategies they have chosen, we can better understand how humanity as a whole has adapted to the great challenge it now faces.

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[170] How Germany Leveraged Digital Health to Combat Covid-19," *The Medical Futurist*, Apr. 9, 2020. Link.
[171] How Germany Leveraged Digital Health to Combat Covid-19," *The Medical Futurist*, Apr. 9, 2020. Link.
[172] Link.
[173] Mark Scott, "'It's overwhelming': On the frontline to combat coronavirus 'fake news,'" *Politico*, Apr. 16, 2020. Link.