Privacy Considerations of Location Tracking in Social Welfare Applications

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COVID-19 rapidly spread worldwide starting in December 2019, reaching its peak during the first quarter of 2021. As of October 28, 2021, COVID-19 deaths have surpassed 5,000,000 globally, with the highest death tolls in the United States, Brazil, and India. Governments scrambled to combat the pandemic using various techniques, including social welfare and pandemic tracking applications. This scramble accelerated the progress of the digital revolution through the proliferation of numerous social welfare applications worldwide. These applications are used for tracking vaccination status, contact tracing, social distancing, symptoms, and positive cases, as well as for enforcing quarantine and lockdown policies and detecting violations. Artificial intelligence and other technology advances raise concerns about security, privacy, and equity since many of these applications work with personal information from one's health records, employment information, and location data. This paper examines such applications in the Kingdom of Saudi Arabia, the Kingdom of Bahrain, and the United States. Develop best practices that can be followed to enhance the security of and equitable access to social applications.

Keywords: COVID-19, contact tracing application, privacy, social, welfare, security

INTRODUCTION

COVID-19 rapidly spread worldwide starting in December 2019, reaching peak numbers in the first quarter of 2021. As of October 28, 2021, COVID-19 deaths have surpassed 5,000,000 globally, with the highest death tolls in the United States (761,354), Brazil (610,491), and India (463,245). Governments worldwide scrambled to combat the pandemic using various techniques, including social welfare and pandemic tracking applications. This scramble to respond accelerated the progress of the digital revolution through the proliferation of numerous social welfare applications worldwide.

Although governments worldwide are not unfamiliar with privacy tracking, with COVID-19, many governments were challenged to discover optimal solutions. Many governments previously had provided an opt-in solution to various social welfare applications, ranging from automobile to health. However, with COVID-19, many governments had to determine the acceptable ratio of hosting privacy implications to society's convenience. In this, many governmental agencies had developed applications, in part, with third-party application developers to assist in social well-being over mobile applications.

These applications are used for tracking vaccination status, contact tracing, social distancing, symptoms, positive cases, enforcing quarantine and lockdown policies, and detecting violations. Integrating artificial intelligence and other technology advances has the potential to raise concerns about security, privacy, and equity since many of these applications work with personal information from one's health records, employment information, and location data. The applications even pull in information from family members.

Social controversy and liberties have been questioned of the value of these applications that world governments or their partners have developed. By developing these applications, multiple politicians throughout the globe have asserted the exertion of privacy rights and an infringement on individual rights compared to collective good rights. Regardless of who has sponsored them, these applications often need to be more substantiated instead of differentiating between singular use cases that either support the everyday society or the typical individual. These applications are often further complicated by the terms of conditions and requirements laid out by the manufacturers or stakeholders, often needing more clarity on public perception due to the language.

In this paper, we examine such applications through case studies and develop best practices that can be followed to enhance the security of and equitable access to social applications. Its significance is a heightened awareness of how emerging technologies can support more equitable access to social net programs. The platform is a content analysis of government policies and current media focusing on automating social net programs. The focus is on policies in effect and stories covered, which point attention to the COVID-19 pandemic.

We investigate the social applications' scope, reach, adoption rates, and effectiveness in tracking the pandemic. We also examine the cultural attitudes toward privacy related to constant location tracking carried out by these applications. We chose case studies from the Kingdom of Saudi Arabia, the Kingdom of Bahrain, India, and several states of the United States because of the applications' high adoption rates and usage and the privacy-sensitive nature of the data they collected and analyzed. We also investigate the reasons behind the proliferation and high adoption and usage rates.

CASE STUDY ONE: THE KINGDOM OF SAUDI ARABIA

The Kingdom of Saudi Arabia (KSA), located in West Asia, encompasses a significant expanse of the Arabian Peninsula. As the fifth-largest nation in Asia, it is inhabited by approximately 35.3 million people. KSA reported its initial COVID-19 case on March 2, 2020, tracing back to a resident who had journeyed to Bahrain and returned to KSA via Iran. A second patient, who traveled alongside the first, was diagnosed on March 4, 2020; both individuals did not disclose their Iran visit. In response to the escalating threat, the Saudi authorities prohibited entries for both citizens and expatriates aiming to embark on the Umrah pilgrimage in Mecca. This restriction was extended, banning travel from nations exhibiting high infection

rates. Consequently, KSA's COVID-19 cases surged from zero on March 1 to a staggering 133 by March 16 (Natto & Alshaeri, 2021).

FIGURE 1
THE KINGDOM OF SAUDI ARABIA CASES PER CAPITA

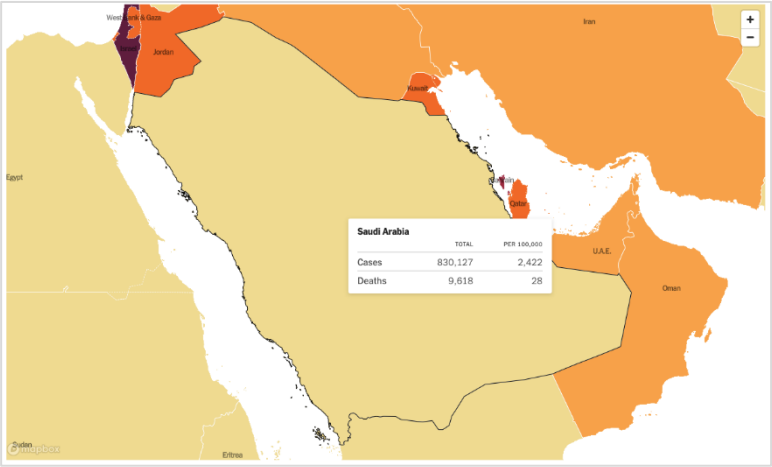


TABLE 1
WORLD COVID-19 CASES AND KINGDOM OF SAUDI ARABIA

	TOTAL CASES	PER 100,000
World	678,791,846	8,841
Saudi Arabia	830,127	2,422

The onset of the pandemic necessitated swift action by the Saudi authorities to mitigate the spread of COVID-19 within the nation's borders. Within a mere six-week span, the virus transitioned from being non-existent in the country to infecting members of the esteemed royal family. This growing peril, impacting ordinary citizens and the monarchy, catalyzed the Saudi government and the Ministry of Health (MOH) officials to pivot towards technological solutions. They outlined specific criteria for these digital tools, encompassing location-based monitoring, movement analytics, efficient contact tracing, and streamlined distribution of welfare resources. This resulted in the development of six mobile applications.

The KSA government established by decree the government agency Saudi Data and Artificial Intelligence Authority (SDAIA). SDAIA developed and implemented three applications that the KSA government mandates: Tawakkalna, Tetamman, and Tabaud. The Tawakkalna app is mandatory for all nationals and expatriates to have activated when visiting stores and institutions. It has a wide range of COVID-19 features and other health-related functions. The Tetamman app allows for COVID-19 test results and provides COVID-19 symptom tracking daily symptoms. In addition, the app provides educational content library and provides alerts. The Tabaud app notifies individuals if they have been exposed to COVID-19 (Alassaf et al., 2021). The remaining applications are SEHA, Mawid, and Sehaty, each of these applications were tailored for COVID-19 in different aspects.

The Tawakkalna (COVID-19 KSA) application. Developed as KSA's primary tool for COVID-19 management, Tawakkalna integrated features for health status disclosure, movement permissions, and contact tracing (Alotaibi et al., 2021). Tawakkalna became pivotal quickly for pandemic control and social welfare distribution. The Tawakkalna App has a high adoption rate, with 23 million users installing the following the government mandate and perception of the application's benefits and improved health and welfare. The app was instrumental in welfare provision, especially in high-risk and quarantined zones

(Alqahtani et al., 2020). Location tracking improved welfare delivery efficiency, reducing instances of misallocations or delays. With recognition of the app's functionality, there are concerns over data privacy and the potential misuse of collected data (Abokhodair et al., 2020). What makes KSA's situation unique is the intersection of global concerns with regional tolerances to governance, culture, and values (Abokhodair et al., 2020).

The global outbreak of COVID-19 landed in the Kingdom of Saudi Arabia uninvited and forced the government and Ministry of Health to adopt measures to react and control the spread of coronavirus. The rapid spread of COVID-19 infects generations of Saudi nationals, sometimes leading to the death of entire families. The introduction of the SDAIA agency and the use of digital technology to build applications targeting the pandemic. KSA requires all the applications to be mandatory for all in KSA. The Kingdom of Saudi Arabia government and MOH protected the National citizens and gauged the KSA citizens' sentiment towards these tools via surveys and sentiment analysis on social media.

CASE STUDY TWO: THE KINGDOM OF BAHRAIN

The Kingdom of Bahrain, an archipelago in the Arabian Gulf, was one of the first countries in the region to respond proactively to the COVID-19 pandemic. Under the guidance of King Hamad bin Isa Al Khalifa, the Bahraini government implemented a multifaceted and agile approach rooted in an understanding of the unique challenges faced by the country.

Early in the pandemic, the government prioritized rapid response, leveraging technology and engaging citizens in a coordinated effort. In addition, a well-structured healthcare infrastructure ensured widespread testing, treatment, and prevention measures. Bahrain's government was strategic and concentrated on transparent public communication, and daily updates were given on infection rates, recoveries, and fatalities (Ministry of Health, Kingdom of Bahrain, 2020). Economic relief packages were implemented to support businesses and individuals affected by the pandemic, and the approach was underpinned by a balance between safeguarding public health and maintaining essential economic activities (International Monetary Fund, 2020).

FIGURE 2
THE KINGDOM OF BAHRAIN CASES PER CAPITA

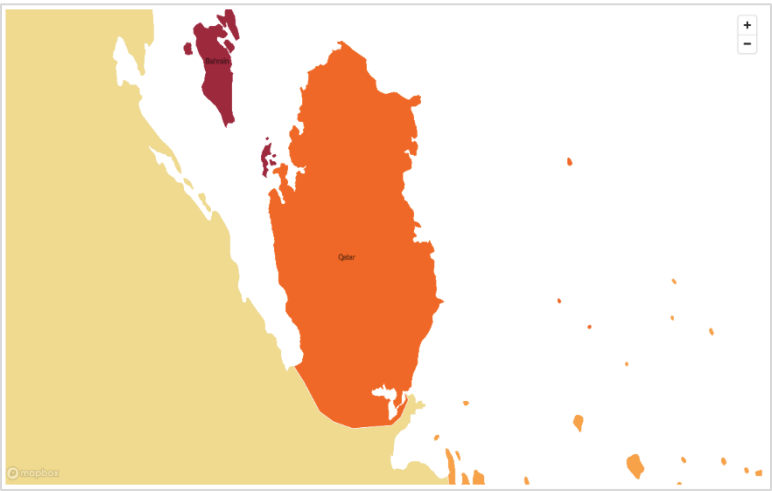


TABLE 2
WORLD COVID-19 CASES AND THE KINGDOM OF BAHRAIN

	TOTAL CASES	PER 100,000
World	678,791,846	8,841
Bahrain	710,693	43,304

Despite the diverse opinions on Bahrain's measures, the Kingdom was assertive in its vaccination drive. Moreover, in the latter part of the year, the Kingdom introduced curfew hours, restricting movements and gatherings during specific times (Khalifa & Khalifa, 2020). Though seen as vital by many, these decisions also faced critiques, as some opposition figures claimed a lack of consultation (Lulwa et al., 2022). Much like the larger cities of the world, Bahrain mandated proof of vaccination or recent negative test results to access several public spaces and amenities, including malls, restaurants, and theaters (Ministry of Health, Kingdom of Bahrain, 2021). This was in line with their proactive testing and tracking initiatives early in the pandemic. Bahrain was also among the first in the Middle East to introduce a vaccine mandate for school-going children (Ministry of Health, Kingdom of Bahrain, 2020).

The Bahraini government launched the 'BeAware Bahrain' app to support these measures - this digital platform offered a QR code-based system, providing access to an individual's vaccination status and test results, enabling easier verification processes (BeAware Bahrain, n.d.). While downloading the application was not mandatory, the platform indicated that it might use location data to optimize its functions. In tandem with 'BeAware Bahrain,' the Kingdom also launched an exposure notification system in collaboration with tech giants; this opt-in feature was designed to notify users if they had come close to an infected individual, aiming to curb the spread (BeAware Bahrain, n.d.). While privacy was a concern for many, the service maintained that user anonymity was paramount.

On the fiscal front, Bahrain secured backing from global health entities during this challenging period. Notable contributions included funding to bolster its contact tracing infrastructure, a cornerstone of the nation's pandemic response strategy; this included grants to strengthen its contact tracing mechanisms, a crucial aspect of the Kingdom's mitigation strategy (World Health Organization, 2021). Additionally, the Bahraini government allocated substantial COVID-related expenditures, with a significant portion reserved for contact tracing and public health campaigns (Ministry of Finance and National Economy, Kingdom of Bahrain, 2022).

The digital transformation induced by the pandemic accentuated the significance of location-based services for Bahrain. These applications have been paramount in contact tracing, resource allocation, and transparent communication with the public. However, as these tools gained prominence, questions regarding privacy implications emerged, the country-mandated users must be informed and willing to consent to data access (KPMG International, 2022). Although 'BeAware Bahrain' focused on health objectives, the government needed to ensure users understood and agreed to the data collection process - a core principle guiding these applications as data minimization. By collecting only the indispensable data required for their specific function, the potential for privacy breaches was managed appropriately. Equally essential was establishing clear guidelines on data retention durations and ensuring timely deletion of unnecessary data.

In summary, as Bahrain navigated the intricate digital landscape during the COVID-19 pandemic, striking a balance between technological advantages and privacy considerations became imperative. The Kingdom aspired to protect public health through reasonable measures and transparent communication while preserving individual rights.

CASE STUDY THREE: INDIA

COVID-19 profoundly impacted India across various facets. The first COVID-19 infection case was reported in Kerala, India, on January 27, 2020, involving an Indian national who had returned from Wuhan

city, China (Andrews et al., 2020). The Community Medicine department of the Government Medical College, Thrissur, initiated contact tracing in collaboration with the District Health Authorities. Identifying both asymptomatic and symptomatic cases took time due to the lack of adequate tools and technologies.

India experienced multiple COVID-19 infection waves. During the prolonged first wave, India had fewer daily COVID-19 cases per million residents than many other countries. However, starting in March 2021, cases surged nationwide. According to 'ourworldindata', India's first wave began in March 2020, peaked in September with over 90,000 daily cases, and dropped to around 10,000 daily cases by February 2021 (Sarkar et al., 2021).

FIGURE 3
INDIA CASES PER CAPITA

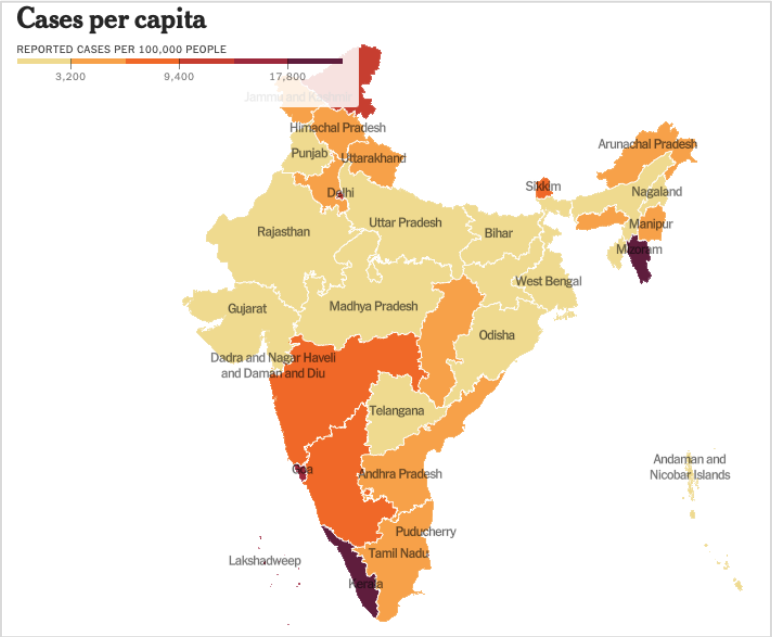


TABLE 3
WORLD COVID-19 CASES AND INDIA

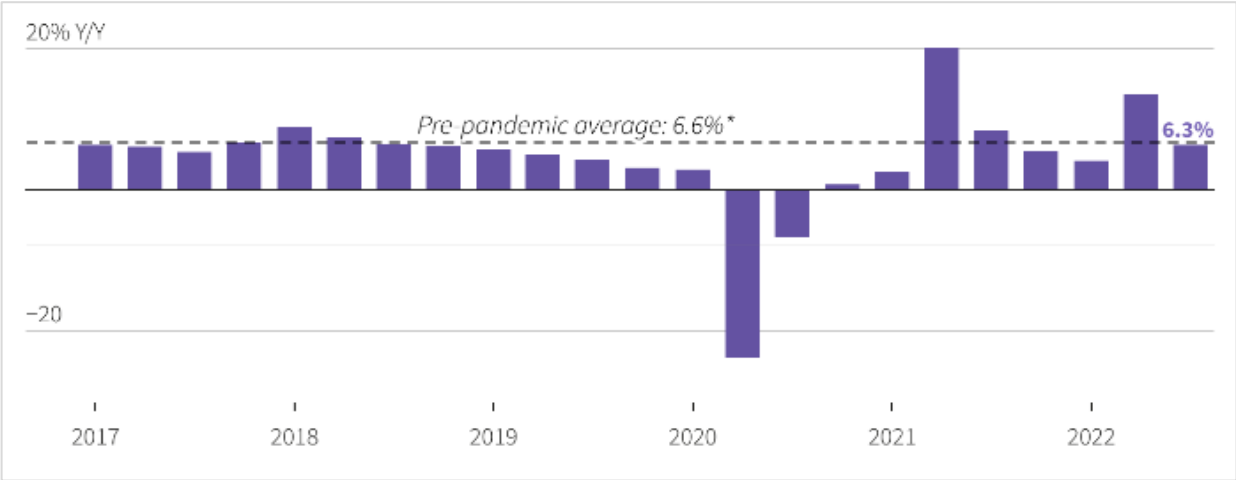
	TOTAL CASES	PER 100,000
World	678,791,846	8,841
India	44,690,738	3,271

On 25 March 2020, India implemented a national lockdown, resulting in a significant economic downturn (Ramakumar & Kanitkar, 2021). The GDP contracted by 7.3% for the 2020-2021 fiscal year, with the first quarter seeing a massive 24% drop. Numerous businesses, especially in the hospitality, travel, and retail industries, incurred massive losses, resulting in extensive layoffs and unemployment. The lockdown triggered an unprecedented reverse migration of workers from cities to their native villages, heavily affecting the urban informal sector. Micro, Small, and Medium Enterprises (MSMEs) and startups encountered financial crises; many paused operations, while others shut down for good. The central government rolled out economic relief packages for the impoverished, farmers, and businesses.

India initiated one of the world's largest vaccination campaigns in January 2021 (Bagcchi, 2021). The indigenous Covaxin and the Oxford-AstraZeneca's Covishield became the campaign's pillars (Darbar et al., 2021). In merely 24 days, India became the fastest country to vaccinate 6 million people. By late 2021,

the economy exhibited recovery signs, with promising GDP growth forecasts for 2021-2022, as depicted in Fig. 4. Learning from the challenges, several states bolstered their healthcare infrastructure, amplifying oxygen production and establishing dedicated COVID-19 centers. The pandemic accelerated digital tool adoption across sectors, including e-commerce and remote working solutions, highlighted by the Aarogya Setu app.

FIGURE 4
INDIA'S ECONOMIC GROWTH TIMELINE



Note. Reprinted from "India's Economy growth pre and post-pandemic" by Reuters.
Retrieved from https://www.reuters.com/world/india/indias-economy-grows-135-yy-april-june-qtr-2022-08-31/

The National Informatics Centre (NIC) introduced the Aarogya Setu app on April 2, 2020, to facilitate contact tracing in India (Gupta et al., 2020). Using both Bluetooth and GPS technologies, the app offers a more effective contact tracing method than Bluetooth alone by combining location data with proximity history. Additionally, it gathers users' demographic data, including name, gender, age, profession, and travel history. Despite its features, continuous user location tracking and movement record-keeping have sparked data privacy concerns, exacerbated by the lack of governing legislation. Nevertheless, the app generates a unique device ID to enhance users' privacy, and location data undergoes a 30-day rolling deletion. Available for both iOS and Android, the app may not support certain features in older OS versions.

A comprehensive study examined the Aarogya Setu app, focusing on user adoption, usefulness, trustworthiness, and acceptance. Reviews were generally positive, showing an 86% user adoption rate (Kodali et al., 2020). App surveillance concerns are especially pertinent in societies with limited civil rights. Yet, in democracies with adequate legal protections, these concerns are diminished. The Indian government's move to open-source the Aarogya Setu app and offer bounties to ethical hackers to identify potential security or privacy issues showcases transparency commitment.

Balancing optimal privacy and public interest can be intricate during public health crises (Tiwari et al., 2020). In such scenarios, the government's primary obligation is to appease the average citizen. There's a case to be made that, occasionally, promoting public health can supersede individual liberty concerns, even in nations with deep-rooted libertarian values.

CASE STUDY FOUR: UNITED STATES

The inaugural introduction of COVID-19 to the United States can be meticulously attributed to the arrival of a flight on January 18, 2020, subsequently re-entering the nation. The Center for Disease Control (CDC) has methodically documented the "inaugural instance of laboratory-validated manifestation of the

2019 Novel Coronavirus within the geographical confines of the United States, substantiated by samples procured on January 18 in the state of Washington." Regulatory entities spanning federal, state, and healthcare sectors collectively construed the 2019 Novel Coronavirus as a global hazard necessitating harmonized governance under the auspices of the World Health Organization (WHO). Prompted by the initiation of WHO's Incident Management Support Team (MIST), the CDC reciprocally activated the National Center for Immunization and Respiratory Diseases (NCIRD) operational framework. In response to the COVID-19 crisis, the U.S. Government promulgated federal legislation; nevertheless, the responsibility for addressing COVID-19 rests with each state and subsequent local administration.

The escalation in COVID-19 cases, coupled with a scarcity of healthcare personnel and strain on all resources, compelled industries to recalibrate their preceding strategies and devise alternative remedies. White-collar professionals transitioned to remote work, educational institutions shifted to remote instruction through platforms like Zoom, and enterprises in the tourism sector shuttered their operations. The technology sector faced the formidable task of accommodating these transformations and the heightened strain on the underlying infrastructure. Legal challenges were raised by both California and New York against these technology giants, arguing a lack of privacy or security (Sella-Villa, 2021). A universal challenge confronted by all was the imperative to anticipate the trajectory of COVID-19 transmission. Apple and Google, the predominant players in the global mobile operating system landscape with IOS and Android, respectively, undertook to deploy software harnessing Bluetooth capabilities for automated contact tracing.

The capacity of the United States government to mandate a uniform technological standard for its populace needs to be improved. Apple and Google collaboratively devised a remedy involving novel Application Programming Interfaces (APIs), designed to harness the Bluetooth signals emitted by smartphones, enabling them to interact with the phones in proximity, thereby constituting a proactive strategy to mitigate the ramifications of the prevailing COVID-19 pandemic. However, this implementation was entirely uncharted, and within 2020 of May, WHO recognized this challenge and issued Ethical Considerations to Guide the Use of Digital Proximity Tracking Technologies for COVID-19 Contact Tracing (Afroogh et al., 2022). However, this approach has encountered three predominant challenges within the United States, contributing to its suboptimal adoption rate.

The foremost challenge pertains to the necessity for public health agencies and local and state governmental bodies to develop mobile applications that are programmed to effectively leverage the available open APIs. While applications focused on contact tracing inherently benefit from a larger user base, the adoption model relies on voluntary participation. Notably, autonomously developed applications necessitated programming designed to abstain from location tracking, thereby hampering the potential to pre-empt the propagation of infections.

The second challenge materializes in the divergent approaches pursued by different states in embracing Digital Contact Tracing. Notably, at the zenith of the COVID-19 crisis, a subset of states, comprising 24 states alongside Washington D.C., had either implemented a contact tracing application or had established systems for exposure notifications. Additionally, some states held the right of privacy statutes respecting private medical information when the information could be argued as highly offensive (Ford & Ludlum, 2021). However, this fragmented adoption further compounds the challenge of achieving widespread efficacy.

The third challenge encapsulates the intricate interplay of factors contributing to the lower-than-anticipated uptake of this approach. This encompasses privacy concerns, technological literacy, and the broader sociopolitical landscape. While the Apple and Google initiative holds promise, its execution encounters multifaceted hurdles that necessitate a comprehensive understanding of the diverse elements.

FIGURE 5
STATES SPLIT ON USING DIGITAL CONTACT TRACING

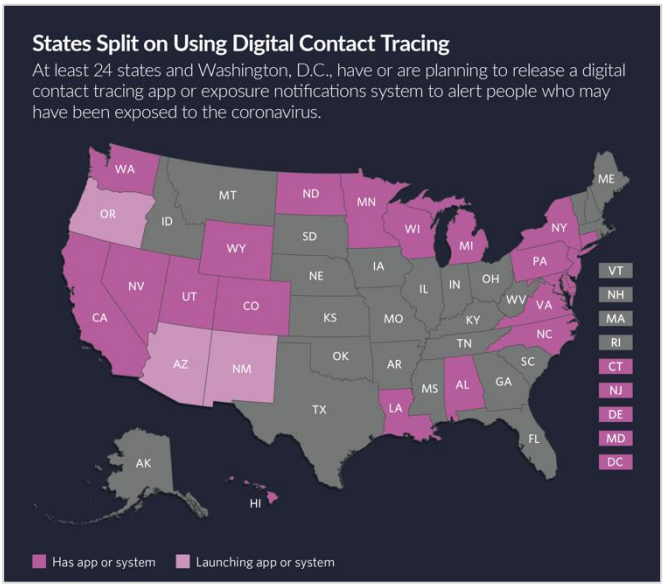


FIGURE 6
EXPOSURE NOTIFICATION ACTIVATION STATUS BY STATE

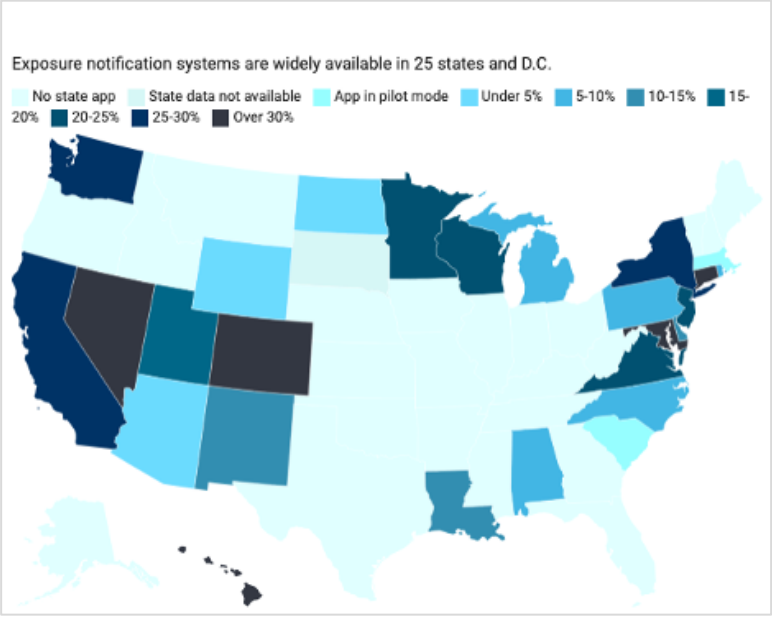


TABLE 4
TOP 10 STATES WITH COVID CASES DURING COVID-19 PEAK

State	Contract Tracing	Cases
California	X	11,300,486
Florida	-	7,627,999
Illinois	-	3,706,263
Michigan	X	3,119,532
New Jersey	X	2,995,906
New York	X	6,706,390
North Carolina	X	3,501,415
Ohio	-	3,449,990
Pennsylvania	X	3,565,278
Texas	-	8,508,204

CASE STUDY CALIFORNIA

The state of California exhibited one of the most strenuous efforts by the state government through the COVID-19 pandemic, becoming a national talking point for many other state governments to use as an example of what should occur and what should not occur. Throughout 2020, California Governor Gavin Newsom enacted multiple stay-home mandates (Gorman, 2020). Additionally, in the latter portion of 2020, California passed a curfew restricting nonessential gatherings between 10 p.m. and 5 a.m. (Iyer & Qu, 2020). As expected, however, the decision by the state government was not popular with all, with another politician from California, then United States House minority leader Kevin McCarthy, claiming the state government did not consult other politicians in the state (Ward, 2020)

FIGURE 7
THE STATE OF CALIFORNIA CASES PER CAPITA

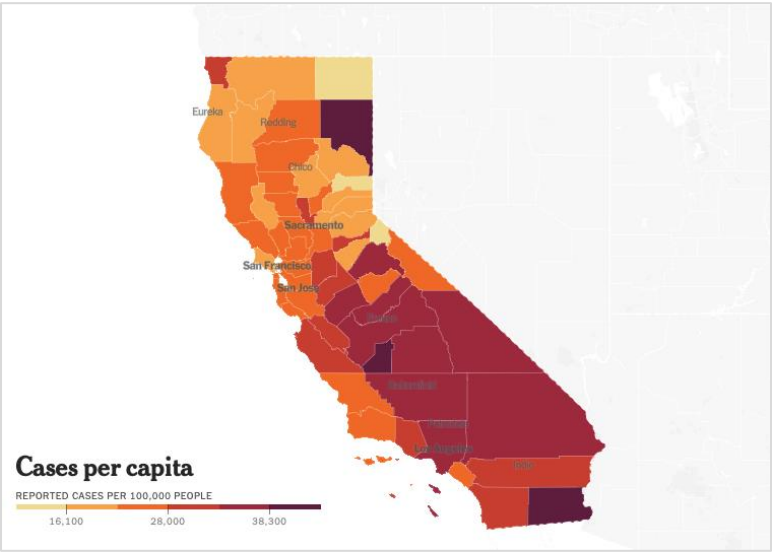


TABLE 5
WORLD COVID-19 CASES, UNITED STATES, AND THE STATE OF CALIFORNIA

	TOTAL CASES	PER 100,000
World	678,791,846	8,841
United States	103,910,034	31,316
California	12,169,158	30,798

Although the response by the state of California had been politicized by members and leaders of the United States government, California undoubtedly provided some of the strictest requirements regarding vaccination proof. Los Angeles County, the most populated county in the United States, mandated that to access restaurants, bars, gyms, nightclubs, movie theaters, hair and nail salons, and sports arenas, individuals had to show proof of vaccination or a recent negative test result ("New Vaccine Mandate Now in Effect in Los Angeles," 2021). Additionally, California became the first state to require student vaccinations that specified the COVID-19 vaccine to attend public school (Office of Governor Gavin Newsom, 2021).

However, to effectively enforce these stringent requirements, California had to provide systems for its citizens to leverage. One of the primary tools was the Digital Vaccine Record (DVR) provided by the state of California to receive a QR code accessible by a SMART Health Card, which a third party of Smart Health provides. Alternatively, accessing the immunization record will provide a link to the email or mobile phone number associated with retrieving personally identifiable information (PII), such as the user's name, date of birth, and vaccination history (*Digital Vaccine Record Portal*, n.d.). Both methods for accessing a Digital Vaccine Record do not require a user to download an application. However, the conditions of use do indicate that IP tracking that may reveal network location is automatically collected and stored.

In conjunction with the DVR that the state of California provided, another application was developed that has since been shut down, the 'CA Notify' service, something that was not downloaded but instead developed and partnered with Apple and Google, respectively, to have exposure notifications. 'CA Notify' was an opt-in service that required turning on Exposure Notifications through the settings of the mobile device operating system, selecting the region and state, and accepting the service's terms and conditions. The state of California had stated that this was intended to be anonymous and to slow the spread of COVID-19, claiming that it did not gather your name, contact information, specific location, or identity of who an infected person interacted with (*CA Notify Home*, n.d.). That said, the use policy of CA Notify is the same as the DVR, indicating that IP tracking that may reveal network location is automatically collected and stored.

Through the COVID-19 Pandemic, the state of California received funding from the CDC, with $205.4 million going to the state government and $59.7 million to the county government of Los Angeles country throughout 2021 ("State Approaches to Contact Tracing During the COVID-19 Pandemic", 2023). In both occurrences, the CDC made allowances and asked to improve contact tracing throughout the state. Before this, California received $3.2 billion from the $1.9 trillion funding of the American Rescue Plan Act. It successfully launched the California Connected awareness campaign through partner funding, again supporting contact tracing. The latest information regarding contact tracing-related money from the state of California indicates that $259.3 million was spent for contact tracing before 2022 and $38.9 million in the future (Sforza, 2022). The latest spend from the state was in February 2022, with SB 115 enacting $1.9 billion for COVID-19-related efforts, including $100 million for contact tracing (Office of Governor Gavin Newsom, 2022).

The state of California has made great efforts and even more extraordinary claims to ensure that no unnecessary location tracking in Social Welfare applications is required. California has shown that it is willing to invest in technology support for its citizens, spending hundreds of millions on this activity. However, an essential consideration for California location tracking is that California is one of the few states in the United States to have its data protection law, called the California Consumer Privacy Act

(CCPA), which defines precise geolocation data as personal information (Focal Point Insights, n.d.). By its own Use Policy, IP Location was automatically collected and stored by 'CA Notify' and the DVR.

CASE STUDY FLORIDA

COVID-19 cases in Florida were contact traced, just as many other states throughout the United States had, as the state was suffering from a large outbreak of cases per capita (See Figure 1). As many other states had, there was encouragement from the Florida Department of Health to stay home if symptoms of feeling sick, aimed to protect the vulnerable (The State of Florida Issues COVID-19 Updates | Florida Department of Health, 2020). Florida was also placed under restricted activities as part of an executive order signed by Governor Ron DeSantis (Klas & Contorno, 2020). Further, Governor DeSantis did proceed to receive the COVID-19 vaccine, attempting to exhibit a model by example. However, Florida firmly opposed having a vaccine mandate, banning employer-mandated vaccine requirements (Governor Ron DeSantis Signs Legislation to Protect Florida Jobs, 2021). Additionally, Governor Ron DeSantis stated that the National Guard of Florida was interacting with incoming flights throughout airports in Florida to enforce self-isolation (Rozsa, 2020).

FIGURE 8
THE STATE OF FLORIDA PER CAPITA

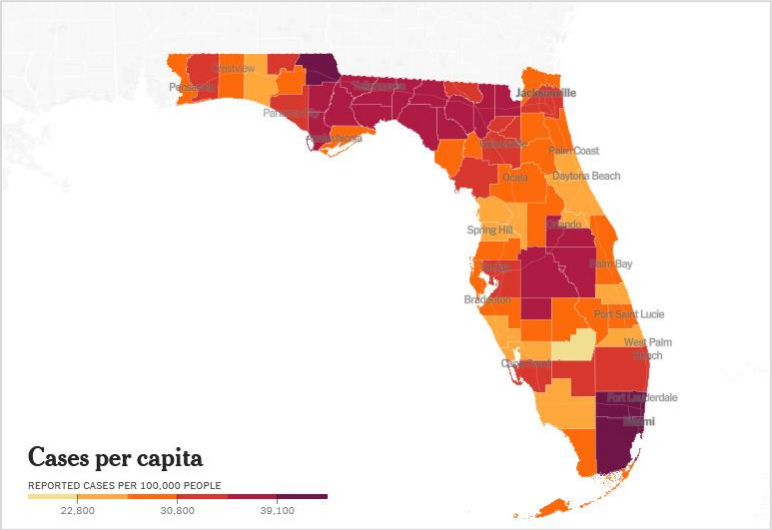


TABLE 6
WORLD COVID-19 CASES, UNITED STATES, AND THE STATE OF FLORIDA

	TOTAL CASES	PER 100,000
World	678,791,846	8,841
United States	103,910,034	31,316
Florida	7,542,869	35,119

Throughout the COVID-19 pandemic, the United States federal government continued to award the state of Florida dollars, totaling as much as $161.5 million during 2021, providing a two-year grant for each occurrence ("State Approaches to Contact Tracing During the COVID-19 Pandemic" 2023). Thus far, despite being a two-year grant, Florida has suspended all training, modeling, and contact tracing as of early 2022, relying instead on local institutions, such as counties or schools, to notify independently.

Additionally, the state of Florida has recommended that all residents independently contact and inform them of the results.

COVID-19 messaging, being politicized as could be imagined, provided the opportunity that has been leveraged throughout COVID-19 and extended into location tracking of Social Welfare Applications leveraged throughout Florida. However, as stated above, Florida began tracing COVID-19 cases like many others. In early 2020, Florida had two separate, opt-in mobile applications, the 'Healthy Together' application, developed by Twenty Holdings, Inc., and the 'Stronger Than C19' application, developed directly by the Florida Department of Health.

Respectively, the 'Healthy Together' mobile application is intended to provide a single pane of glass to optimize contact tracing of users, collecting the following data linked to the user, according to Twenty Holdings, Inc. on their Apple Store page: Health & Fitness, Contacts, Identifiers, Sensitive Info, Contact Info, User Content, Usage Data, Diagnostics, and Other Data. Alternatively, the mobile application of 'Stronger Than C19' does not self-report on the Apple Store page, but from the Florida Department of Health privacy page, we can observe that the data collected includes location data that is shared with any government inquiries, with the data including the IP address which the privacy policy states indicate which city is being accessed. An additional note for the 'Stronger Than C19' application is the application was developed by the state of Florida, causing it to adhere to the Florida "Sunshine" law, which allows a right of access to state and local officials (The "Sunshine" Law | My Florida Legal, n.d.). On the opposite side, Twenty Holdings, Inc. is commonly known as 'Twenty,' a company based out of New York to foster human connection, according to their LinkedIn page. Additionally, the son of the founder of Twenty Holdings, Inc. is a donor to former President Donald Trump, causing speculation about the political incentive due to the emergency contract being enacted through a no-bid (Contorno, 2021).

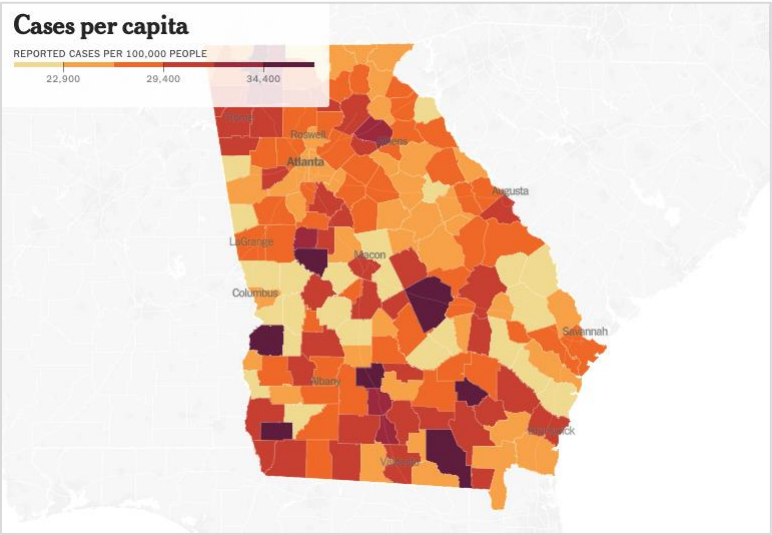
CASE STUDY GEORGIA

The state of Georgia, like many others in the United States, experienced a significant impact from the novel Coronavirus (COVID-19) outbreak. The virus was first detected in Georgia on March 3, 2020, and just nine days later, the state reported its first COVID-19-related death on March 12. In response to the situation, Georgia's Governor Brian Kemp promptly requested $100 million from state funds, declared a public health emergency, and mobilized the National Guard to assist in mitigation efforts. While implementing various measures, including social distancing protocols, business closures, and mask mandates, to contain the spread of the virus. Georgia witnessed a surge in cases, putting an immense strain on its healthcare system and frontline workers.

TABLE 7
WORLD COVID-19 CASES, UNITED STATES, AND THE STATE OF GEORGIA

	TOTAL CASES	PER 100,000
World	678,791,846	8,841
United States	103,910,034	31,316
Georgia	2,984,923	27,992

FIGURE 9
THE STATE OF GEORGIA PER CAPITA



In response to the ongoing proliferation of COVID-19, the Georgia Department of Public Health (DPH) enlisted and dispatched 1,300 contact tracers and case investigators across the state. These professionals are tasked with interviewing those diagnosed with COVID-19 and subsequently notifying, quarantining, and testing individuals potentially exposed to the virus. "For contact tracing to be efficacious, education remains paramount," noted Georgia DPH Commissioner Kathleen E. Toomey, M.D., M.P.H (Toomey, 2020). The efficacy of contact tracing hinges on the proficiency of the newly appointed staff and the community's willingness to respond and provide accurate details if they receive a positive COVID-19 diagnosis. Members of the contact tracing team do not gather any PII in their support efforts for those affected by COVID-19. Moreover, the state's contact tracing initiative operates autonomously from technological solutions; GPS or Bluetooth mechanisms are not used to monitor resident's movements.

The absence of a comprehensive statewide initiative leveraging the technological collaboration between Apple and Google for contact tracking or exposure notification. This left residents unable to proactively receive notifications if they had been in the area with someone who had tested positive for COVID-19. Densely populated areas, such as college campuses, posed the highest risk of exposure. The Georgia Institute of Technology (Georgia Tech) protected its faculty, staff, and students by developing the NOVID application (COVID-19 Radar).

NOVID is a smartphone app that uses Bluetooth technology to anonymously track users' proximity. Users testing positive for COVID-19 can anonymously notify other users in close contact with them. NOVID also provides users personalized data on the social proximity of COVID-19 cases and exposed contacts. Its developers have praised NOVID for its innovative approach to contact tracing. The app is effective in identifying and notifying users who have been exposed to COVID-19. NOVID has also been credited with helping reduce the virus's spread on college campuses. A study published in the journal Nature Medicine found that NOVID could identify 90% of close contacts of COVID-19 cases. The study also found that NOVID reduced the risk of transmission by 50%. NOVID is a valuable tool for contact tracing and preventing the spread of COVID-19. The app is easy to use and can be downloaded for free. NOVID is a valuable resource for individuals, businesses, and organizations looking to protect themselves from COVID-19. (Loh et al., 2022).

At the height of the pandemic, Georgia was ranked 14th among US States with 2,343,807 COVID-19 cases. The state of Georgia's approach to contact tracing was a labor-based system and depended upon members of the tracer team surveying a resident after a positive test and the resident's willingness to provide accurate details. A target group of residents had the opt-in capability to use a smartphone application for

contract tracking and notification exposure. The highest adaption rate to the NOVID application was 30% post faculty- and student promotion of installing and using the application. In a Georgia Tech student-led Reddit forum, many students opposed installing the application due to lack of trust in protecting PII.

At the height of the pandemic, Georgia was ranked 14th among US states with 2,343,807 COVID-19 cases. The state's contact tracing approach was labor-intensive, relying on tracer team members to survey residents who had tested positive for the virus. This approach depended on residents' willingness to provide accurate contact information.

A target group of residents was also allowed to use a smartphone application for contact tracing and exposure notification. The NOVID application uses Bluetooth technology to anonymously track the proximity of users. If users test positive for COVID-19, they can anonymously notify other users who were in close contact with them. The highest adoption rate of the NOVID application was 30%, following promotion by faculty and students at Georgia Tech. However, many students in a Georgia Tech student-led Reddit forum opposed installing the application due to concerns about protecting personally identifiable information (PII).

The low adoption rate of the NOVID application highlights the challenges of implementing contact tracing during a pandemic. Labor-intensive approaches can be difficult to scale, and voluntary contact tracing apps may need to be more widely adopted.

The lack of trust in protecting PII is a significant barrier to adopting contact tracing apps. This is a valid concern, as there have been reports of data breaches and misuse of personal information. However, it is important to note that the NOVID application is designed to protect user privacy. The app does not collect personally identifiable information; all data is stored on the user's device.

CASE STUDY NEW YORK

On March 1, 2020, an individual aged 39, employed in the healthcare sector, returned to Manhattan from Iran, unknowingly carrying more than just their luggage and souvenirs. This person became the first documented COVID-19 case in the state, marking the beginning of the outbreak. However, suspicions arose and were later confirmed that New York had already experienced around 10,000 undetected COVID-19 cases as early as February 2020.

During a press briefing, Mayor Bill de Blasio and Governor Andrew Cuomo jointly conveyed that despite the emergence of COVID-19 cases, the risk of New Yorkers contracting the virus remained relatively low. It took 11 days and 2,314 infections for Governor Cuomo to enact an executive order that prohibited gatherings exceeding 500 individuals and imposed a maximum capacity of 250 people for public venues. Mayor de Blasio's executive order, signed on March 16, mandated the closure of all theaters and clubs.

FIGURE 10
THE STATE OF NEW YORK'S CASES PER CAPITA

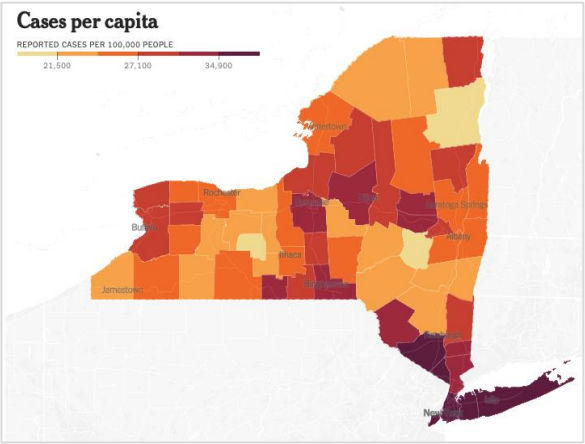


FIGURE 11
THE CITY OF NEW YORK CASES PER CAPITA

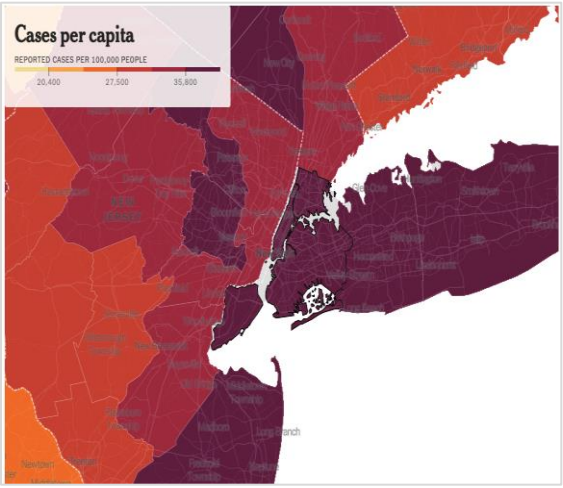


TABLE 8
WORLD COVID-19 CASES, UNITED STATES, AND THE STATE OF NEW YORK

	TOTAL CASES	PER 100,000
World	678,791,846	8,841
United States	103,910,034	31,316
New York	6,805,271	34,982
New York City	3,252,967	39,019

Although the state of New York devised a comprehensive strategy for managing the COVID-19 situation, the execution of the plan struggled to cope with the rapid surge in cases. Initially, the program did not incorporate measures such as location tracking, exposure notifications, or applications to address social welfare concerns. Instead, the state relied on disease detectives. In a conference call with reporters, Governor Cuomo stated, "we have about 15,000 people statewide who do contract tracing, but we are

looking for a technology-based solution." The solution in development was based on and used the open technology access made available by the collaboration between Apple and Google. The application name is COVID Alert NY and was released alongside New York's partner state, New Jersey, who titled their application COVID Alert NJ.

The "COVID Alert NY" is a COVID-19 tool designed primarily for New Yorkers aged 18 and above. Its objective is to provide a reliable solution for COVID-19 contact tracing and exposure updates without the need to gather personal or locational data, thus preserving user confidentiality. The app employs the Exposure Notification System to alert users when they've been in proximity to an individual who has received a positive COVID-19 diagnosis. "Close contact" is delineated as being within a six-foot radius of the infected individual for at least 10 consecutive minutes. Users must opt into the notification system to benefit from these alerts, ensuring they are informed if they've been close to someone who later tests positive for the virus.

Days after the initial list COVID Alert NY was released, the application downloads were over 300,000 times; however, the population of New York is nearly 20 million people. (Wetsman, 2020) At the height of COVID 19, over 1 million users downloaded the COVID Alert NY application to their mobile devices at the end of 2020. Since the date of release 2100 New Yorkers with the COVID Alert NY app tested positive for COVID-19. Approximately 700 of those users marked their status as positive COVID test in the application; their actions triggered 630 exposure notifications to other application users per Erin Silk (Osmanlliu et al., 2020).

The app has garnered a range of feedback from its users. Some commend its user-friendly interface and robust privacy features, while others express dissatisfaction with installation issues and frequent crashes. Notably, there's also a segment of users who haven't provided feedback, likely because they've forgotten about the app post-installation. Although the app upholds its promise of privacy and eschews location tracking, it hasn't seen widespread adoption as hoped. Thus, the state did not fully realize the potential benefits envisioned from the app's initial objectives. Nonetheless, it's worth highlighting that the "COVID Alert NY" neither compromised user privacy nor disclosed their locations.

CONCLUSIONS

In reaction to the pandemic, nations across the globe enacted a multifaceted approach to contain and reduce transmission. Efforts expedited vaccine research, endorsement, and distribution, primarily under emergency use authorization. Each nation or state employed a suite of mitigation tactics tailored to their demographics' unique challenges and characteristics. Tests were administered and quarantines were mandated for confirmed cases, with some countries imposing this directly at their entry points. Nations instituted lockdowns that varied in scale, from specific neighborhoods to entire metropolises or regions.

In response to the COVID-19 crisis, various entities pioneered mobile software applications specifically designed for digital infection tracing. A significant proportion of these apps emanated from official governmental agencies, while others materialized from collaborative efforts involving public-private partnerships (PPPs), non-governmental organizations (NGOs), and private sector ventures. While the functionalities of these apps differ; their core capabilities primarily encompassnCOVID-19 testing and immunization infection tracing, contact tracing, location tracking, quarantine-enforcing, and vaccination evidence.

The primary obstacle to the widespread adoption of pertinent technology remains user privacy concerns. To address this challenge, nations have employed a spectrum of strategies. Some have transitioned to decentralized platforms emphasizing user privacy, as exemplified by the Exposure Notification system developed by Apple and Google. At the height of the pandemic, some nations implemented restrictions that made routine tasks, such as accessing public offices, shopping malls, and attending concerts, contingent upon app usage, a tactic observed in countries like Bahrain and KSA. There were legal mandates enforcing the utilization of specific apps, a course of action pursued by nations such as Slovenia. Numerous counties engaged in extensive advocacy and public awareness campaigns to accentuate the app's merits and its role in public safety.

The Kingdom of Saudi Arabia's utilization of location tracking in social welfare applications served a dual purpose: disease control and ensuring resources reached those in need. However, this raised ethical questions on surveillance, individual freedoms, and data privacy. This debate between public health benefits and individual freedoms is not new but has become increasingly pronounced in the digital age. What makes KSA's situation unique is the intersection of these global concerns with regional nuances related to governance, culture, and values (Abokhodair et al., 2020). Users of the Tawakkalna app reflected that installing and using the application was a part of their national duty, and they were obliged to follow the county mandate. Tawakkalna grew to offer 100 services and the application is available in 75 countries (Saudi Gazette).

Bahrain's rapid adaptation to the pandemic showcased its agility in embracing digital tools while addressing public health concerns. This experience positions the Kingdom well for a future where technology and health intersect even more profoundly; the successful implementation of digital platforms like 'BeAware Bahrain' could serve as a foundation for developing more advanced health monitoring and management systems, potentially integrating AI-driven predictive analytics to address health crises preemptively. Moreover, having navigated the delicate balance between data utility and privacy, Bahrain will likely be at the forefront of crafting robust digital ethics and personal data protection policies (Khalifa & Khalifa, 2020). These foundational experiences could spur innovation, positioning Bahrain as a leader in the Middle East for health-tech solutions and digital policy frameworks. However, continuous engagement with its citizenry will be essential, ensuring that as technology progresses, the people's rights and perspectives remain central to its evolution.

The adoption rate of India's COVID-19 mobile tracking application, "Aarogya Setu," has increased due to 'App Usefulness,' 'Ease of Use,' and 'Perceived Privacy Risk'. The perceived privacy risk significantly impacts the intention to use the Aarogya Setu app. While many states have developed their own COVID-19 mobile tracking applications, the adoption rate of the Indian government's "Aarogya Setu" app has fostered trust between the government and its citizens. However, the app's technical specifications should be publicly available for the utmost transparency so the community can critically evaluate and understand them. The Ministry of Home Affairs mandated the app's installation on 1st May 2020. Still, such mandates might not necessarily enhance trust. Data minimization should be a key principle, ensuring maximum benefit from minimal personal data collection. Only relevant privacy data that directly aids contact tracing should be collected. For instance, the 'profession' data collected by Aarogya Setu is not relevant to contact tracing. Data collected by the app should be properly anonymized to prevent unauthorized sharing of user records. To curtail person-to-person transmission, technological solutions incorporating privacy are crucial in combating the pandemic.

In the United States, the consensus on dealing with the COVID-19 outbreak was split mainly along political lines. The federal government has yet to launch their mobile applications, instead relying on local, state, or municipality to develop or invest in their own. However, the federal government participated in widescale organizations such as WHO to provide additional research and insights into the pandemic. In heavily Democrat-controlled states, there was an observed long-term adoption of contact tracing and funding for each, as well as public advocacy for such applications, observed in states such as California or New York. Conversely, in Florida or Georgia, primarily Republican-controlled, adoption had been on the short term with no long-term goals or motivations pushed beyond them. These Republican-controlled states needed a high adoption rate for success, with many of the applications being shown as valuable but with a low adoption rate by the public. Throughout the United States, geographic consideration of tri-state areas where residents work across state borders without contract tracing applications is impacted by the lack of applications in their home state. A mix of private and public applications was used for contact tracing, furthering the division on adoption and the enforcement of application tracking or exposure. Along with this, many of the applications had issues with optimization factors, such as crashes or installation issues. With this, many states had yet to fully witness the extent of these applications' optimization, or lack thereof, due to the optimization issues that plagued them.

In conclusion, digital technology and the platform applications are built on have a varying impact on social welfare. In some countries, states, and local municipalities, the applications do not provide the

benefits for which they were developed. One paper showed that Bluetooth's distance measurements were so inaccurate on a tram—throwing false positives and false negatives for contact—that the app wasn't any more useful than notifying people randomly (COVID contact tracing apps are far from perfect). Despite the challenges, contact tracing is essential for preventing the spread of COVID-19. Contact tracing can help break the transmission chain by identifying and isolating infected individuals. The reduction of COVID-19 from a pandemic did not mean the virus went away; it only meant the number of cases no longer met the threshold to be considered a pandemic. As of this writing, COVID-19 cases and the new variant are rising again. Finding ways to improve the effectiveness of contact tracing is important. This may involve developing new technologies or increasing public trust in contact tracing apps.

FURTHER RESEARCH OPPORTUNITY

Future research should be around the development of guidelines for independent audits of contact tracking apps to ensure they meet stated privacy, security, and efficacy claims. The research should be around effective communication strategies to inform the public about privacy features and the importance of contact tracing. Research should be on the benefits of transparency in terms of public trust and app efficacy. Exploration and publishing of privacy-preserving technologies, such as types of encryption methods used, to ensure private data remains private and secure. Does the definition of a global society inherently mean all countries share a common culture? Not all nations currently agree that privacy is a human right. The question remains on how to get nations to agree on a uniform application standard, which should lead to higher adoption rates.

Exploring any implications from the public perception of COVID-19 that impact the effectiveness of location tracking of social welfare application should be examined. The paper observed multiple occurrences in which COVID-19 was used from a national perspective or a political perspective. Due to this phenomenon, there is an opportunity for research to be done regarding specific social welfare applications that are not related to an international pandemic that may have influenced this due to media attention. Applications that deal with public functions such as law enforcement, public health, fire safety, or any transport applications should be evaluated to examine if public perception is similar in COVID-19 location tracking applications.

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