



EXPLORING USER-UP TAKE OF DIGITAL CONTACT TRACING (D-CT) APPS

A PRACTITIONER GUIDE

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ABOUT OUR LAB

Our research aims to shed insight into the different ways digital technologies are used in disasters and emergencies, the challenges and risks, and benefits and opportunities associated with digital technology use. We seek to provide strategies for guidance, and support efficacy-focused, ethical, low-risk interventions around the world. Our research adopts systems and complex networked perspectives, where we creating understanding through interconnectivity. We engage experts and organizations, both academic and practitioner, across disciplines to evolve research at the intersection of systems to enhance context-driven understanding.

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EXPLORING USER-UPTAKE IN D-CT APPS

MODULE 2.

Case Study. Iceland

Laksmiina Balasubramaniam, Rebecca Babcock, Jennie Phillips

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Disaster & Emergency Management (DEM) & Dahdaleh
Institute for Global Health Research (DIGHR)
York University, Toronto ON, Canada



2.1. Study Overview

2.1.1 Background

At the onset of the COVID-19 pandemic, Digital Contact Tracing (D-CT) emerged as a complement to Manual Contact Tracing (M-CT) to help enhance the capacity of global health systems to track and control the rapid spread and impact of the virus. This innovative approach to contact tracing attracted global attention due to its immense potential to enable faster and more widespread tracing of the virus among symptomatic and asymptomatic infected populations, while also compensating for lower resource availability and physical distancing rules hindering face-to-face care. D-CT apps and interventions from eBracelets to QR codes surged around the world, in the hope that they would make a substantial impact on curbing the global spread of the virus.

To date however, little research exists demonstrating the true impact of these tools. Specifically, despite the widespread implementation of these tools, there is little evidence that shows that D-CT tools (most often apps) do more good than harm. Coupled with issues pertaining to human rights, privacy, efficacy, and digital inclusion, one of the major problems faced with D-CT interventions (mainly those that are voluntary) is the low level of user engagement in these apps – engagement meaning uptake of the app (download and registration), but also using and updating the app, reporting a positive diagnosis through the app, and reacting to an exposure alert received through the app (see our four-stage continuum of D-CT app engagement outlined in Module 1). Looking at uptake of D-CT apps alone, rates vary drastically across different contexts. Ireland and Iceland, for example, have some of the highest rates amongst the countries studied at approximately 43% and 40% respectively, while places like Cyprus or South Africa fall below 1%. And, while many argue that any degree of uptake can make a difference,¹ the dominant perception is that all of these rates are insufficient to make a substantial impact on tracing and controlling the virus. In an effort to better characterize the relationship between user engagement and app effectiveness, taking into account there is currently no magic uptake number, research is needed to understand why user-uptake varies between countries.

Through a preliminary literature review and an interdisciplinary workshop, our research team found this problem can be partly attributed to the lack of recognition and understanding of the target users of these apps. Yet, little is known regarding what incentivizes versus inhibits people from downloading these apps around the world, how context plays a role, as well as the association of perceived benefits and risks with user engagement. As part of [The Digital Global Health and Humanitarianism \(DGHH\) Lab's](#) larger study on the factors impact user-engagement across the four-stage continuum, this study focuses specifically on trying to address this gap by exploring stage 1 – user-uptake of D-CT apps – across various countries.

¹O'Neill, P. (2020, June 5). No, coronavirus apps don't need 60% adoption to be effective. MIT Technology Review. Retrieved from <https://www.technologyreview.com/2020/06/05/1002775/covid-apps-effective-at-less-than-60-percent-download/>

2.1.2 Methodology

This research asks the following research question:

Why is there higher user-uptake of D-CT apps in some countries over others?

This question is addressed with the following sub-questions:

- i. How does uptake vary across contexts?
- ii. What factors influence uptake across contexts?
- iii. How does risk-benefit perception influence uptake?

To answer these questions, we first established the scope of our research. Our focus is on user-uptake of D-CT apps (the most prevalent form of D-CT interventions worldwide) implemented by governments around the world at the national level, that are voluntary to download, and primarily decentralized in their data collection (a measure that mitigates privacy and human rights concerns that are widely recognized as a factor that deters app engagement).² Second, a multiple case study approach was used to generate country-specific understanding of user-uptake of D-CT apps and address our research questions. Cases selected include: Iceland, Cyprus, Ireland, Scotland, and South Africa. Data was collected through interdisciplinary workshops, interviews, and meta-analysis of existing peer-reviewed and grey literature. Research findings were analyzed through a systems-approach based on Bronfennbrenner's ecological systems theory to identify varied contextual factors that influence uptake (through a risk-benefit lens).³ Bronfennbrenner's theory aims to define user behaviour as a product of intrinsic and extrinsic interactions and influences with different levels in their surrounding system: individual (micro-level), community (meso-level), and system (macro-level). Research findings are presented through a series of modules (identified in Section 2.1.4 below) through an introduction to D-CT and user-uptake; case study; systems analysis of factors identified that influence uptake; and recommendations and future research. For a more detailed overview of our research approach, please see the full methodology.

2.1.3 Overview of Cases & Factors Identified

As will be shown through the five case studies, **eight factors** that can explain uptake across the individual (micro), community (meso), and system (macro) level dimensions have been identified. Each factor is explained below.

1. **Perceptions of Data Collection & Management** - how people perceive actual data collection and management as it relates to privacy and trust; and individual understanding of privacy and security (independent of actual privacy and security measures built into D-CT apps).

²Lomas, N. (2020, April 6). EU privacy experts push a decentralized approach to COVID-19 contacts tracing. TechCrunch. Retrieved from <https://techcrunch.com/2020/04/06/eu-privacy-experts-push-a-decentralized-approach-to-covid-19-contacts-tracing/>

³ Wikipedia Contributors. (2019, February 10). Ecological systems theory. Wikipedia; Wikimedia Foundation. Retrieved from https://en.wikipedia.org/wiki/Ecological_systems_theory

2. **Sense of Community** - the level of shared trust, shared identity, sense of duty, and/or communitarian values individuals have in relation to their community; and the strength of ties/connectedness individuals have with each other.
3. **Communications & Misinformation** - the timeliness, transparency, method, and nature of information provided to the nation alongside the prevalence, spread, and control of misinformation.
4. **Accessibility & Inclusion** - the degree to which D-CT apps are equally accessible to, usable for, and inclusive of, the entire population, as well as the level of discrimination and marginalization that results from interventions that fail to account for the digital divide or socially vulnerable populations.
5. **Trust in Public/Private Institutions** - the widespread level of trust and faith in public institutions (e.g. government, response agencies) and private institutions (e.g. internet corporations like Google, Apple, as well as the developers of D-CT apps).
6. **Policy & Governance** - the use of, and adherence to, policies and governance mechanisms that regulate the development, implementation, and use of the app.
7. **Response Infrastructure** - the ability of the health infrastructure alongside the first-line response and emergency management infrastructure to manage the COVID-19 pandemic (such as access to testing, and the capacity to respond to and treat the virus).
8. **Digital Capability** - the ability of D-CT apps to effectively and efficiently serve their purpose and facilitate the management of the pandemic.

2.1.4 Practitioner Guide Outline

The findings of this study are presented through eleven modules including:

Module 00 – Executive Summary

Module 0 - Methodology

Module 1 - Digital Contact Tracing (D-CT) and User-Uptake: A Primer

Module 2 - Case Study: Iceland

Module 3 - Case Study: Cyprus

Module 4 - Case Study: Ireland

Module 5 - Case Study: Scotland

Module 6 - Case Study: South Africa

Module 7 - Analysis of User-Uptake Factors: Individual- & Community-Level Influences

Module 8 - Analysis of User-Uptake Factors: System-Level Influences

Module 9 - Recommendations & Future Research

2.2. Module Overview

This module aims to explore Digital Contact Tracing (D-CT) developed and implemented in Iceland for the COVID-19 response. Focus is on their D-CT app, *Rakning C-19*, and understanding user-uptake. The case study begins with a brief overview of the country's overall response to COVID-19 and the impact of the virus on the country. Following, we explain Iceland's app by describing how it emerged, how it is designed

and functions, how users engage with the app across the whole user-engagement process, and what user-uptake looks like in the country. The next section describes the main factors that emerged in our research for this country that suggest influencing user-uptake within the country's context. This section ends with a brief conclusion.

2.3. Case Study

2.3.1. COVID-19 in Iceland

Iceland saw the first confirmed case of COVID-19 on 28 February 2020 and as of 28 January 2021, had 6,001 confirmed cases of COVID-19 with 29 deaths.⁴ In May 2020, Iceland was reporting more than 500 confirmed cases per 100,000 people – putting it among one of the highest confirmed infection rates in the world.⁵ However, their death rate from COVID-19 is among one of the lowest (at 0.05%) as of January 2021.⁶ The high case count and the low death rate can be explained by Iceland's proactive pandemic response.

Prior to the first positive case, Iceland had activated the Icelandic Pandemic and Influenza Preparedness Plan (IPIPP) in mid-January 2020.⁷ Combined with aggressive testing and contact tracing, Iceland was able to flatten the curve by the end of April 2020 with few new cases. This low case count was maintained throughout the summer months with a slight increase in mid-August 2020. By the end of September 2020, Iceland saw a spike in coronavirus cases which was maintained into the end of October 2020 at which point the number of cases started to decrease. The curve flattened by mid-November and a decreasing trend has been continuing throughout January 2021.

Isolation and quarantine, by region



	Isolation	Quarantine
Greater Reykjavik	468	632
Suðurnes Peninsula	30	74
South Iceland	56	56
East Iceland	2	
Northeast Iceland	115	131
Northwest Iceland	9	5
West Fjords	3	3
West Iceland	24	77
Unknown	3	11
Abroad		

Figure 2.1.0 COVID-19 Isolation and Quarantine Cases by Region^{8*}

⁴ Worldometer. (2020). Iceland Coronavirus Cases. Worldometer. Retrieved October 24, 2020, from <https://www.worldometers.info/coronavirus/country/iceland/>

⁵ Bishop, T. (2020, May 17). COVID-19 lessons from Iceland: How one Nordic country has all but stopped the virus in its track. GeekWire. Retrieved from <https://perma.cc/RKS6-LG4G>

⁶ Johns Hopkins. (2020). Coronavirus Resource Center: Mortality Analyses. Retrieved from <https://coronavirus.jhu.edu/data/mortality>

⁷ Sigurgeirsdóttir, S. (2020, June 11). Policy Responses for Iceland. COVID-19 Health System Response Monitor. Retrieved from <https://www.covid19healthsystem.org/countries/iceland/livinghit.aspx?Section=5.%20Governance&Type=Chapter>

⁸ Government of Iceland. (2020). Tracing app Rakning C-19. Retrieved from <https://www.covid.is/data>

*Data is current cases as of 7 November 2020 (not cumulative).

2.3.2. Evolution of the Digital Contact Tracing App

To supplement the manual contact tracing efforts of the Contact Tracing Teams,⁹ the Icelandic government released their GPS-based, decentralized contact tracing app – Rakning C-19 – on 1 April 2020.¹⁰ Rakning C-19 is open source and created as a joint project of the Department of Civil Protection and Emergency Management and the Directorate of Health.¹¹ The app was created with the volunteered support of private companies in Iceland including: Aranja, Kolibri, Stokkur, Sensa, Samsyn, Icelandic Genetics, and Syndis.¹²

Iceland is said to be moving towards a Bluetooth-based app using the GAEN interface.¹³ This shift is to reduce the workload of the manual contact tracing team as rather than trying to identify people who may have been exposed to COVID-19 by relying on location data, the Bluetooth-based app will create records of individuals who have come into contact with individuals who tested positive for COVID-19. The new app will maintain integration with the manual contact tracing team.

The app is the focus of the government's digital efforts to combat COVID-19, other digital solutions (such as QR codes or health passports) are not currently in use.

2.3.3. How the app works/design

Table 2.1.0: Rakning C-19 App Details

	Iceland
Name of the App	Rakning C-19
Developer(s)	<ul style="list-style-type: none"> ❖ Department of Civil Protection and Emergency Management ❖ the Directorate of Health
Decentralized or Centralized Data Collection	Decentralized
Bluetooth, GPS, Both, Other	GPS-based
Type of App: GAEN or Other	Other: GPS-based, open-source app
Mobile Requirements: e.g. iOS, Android, version	iOS 9.0 and up Android 5.0 and up
Alternate functionality?	<ul style="list-style-type: none"> ❖ chat features for users to speak to public health officials ❖ additional information for tourists
Data Collected (Voluntarily) By App	<ul style="list-style-type: none"> ❖ Location data

⁹ Ciric, J. (2020, March 26). Tracking app may assist Iceland with Coronavirus contact tracing. Iceland Review. Retrieved from <https://www.icelandreview.com/sci-tech/tracking-app-may-assist-iceland-with-coronavirus-contact-tracing/>

¹⁰ National Crisis and Coordination Centre. (2020, April 3). *Status report: Coronavirus- COVID-19* [Press release]. Retrieved from <https://www.almannavarnir.is/english/pandemic-influenza/influenza-a-h1n1/>

¹¹ Ciric, J. (2020, March 26). Tracking app may assist Iceland with Coronavirus contact tracing. Iceland Review. Retrieved from <https://www.icelandreview.com/sci-tech/tracking-app-may-assist-iceland-with-coronavirus-contact-tracing/>

¹² COVID-19: Tracing with the help of apps. (2020, April 4). Directorate of Health. Retrieved from <https://www.landlaeknir.is/um-embattid/frettir/frett/item40650/covid-19-smitrakning-med-adstod-apps>

¹³ Personal communication, October 9, 2020

	❖ telephone number
Data Collected (Voluntarily) By Government	❖ Location data ❖ telephone number
Data Collection permission	Voluntary
Data Deletion period	14 days for data on user's phone 14 days for data uploaded (with consent) to a centralized database

Rakning C-19 is a decentralized, GPS-based contact tracing app that was developed as a joint project of the Department of Civil Protection and Emergency Management and the Directorate of Health.¹⁴ In order to download the app, phones must have Android 5.0 and up or iOS 9.0 or later.¹⁵ When individuals download the app they are asked to enter their phone number which is stored in the app's database stored on secure servers hosted by Sensa.¹⁶ For the app to properly function, the individuals must consent to share their phone's location data at all times. The app collects GPS data and this is stored on the user's own device and deleted after 14 days.

If an individual tests positive for COVID-19, they can choose to consent to share their location data with the government's contact tracing team and then their location information will be stored in the team's database for 14 days. This double-opt in design, where individuals must opt to download the app and then opt to share their location data with the contact tracing team if they test positive protects the privacy of users. The app also has chat features for users to speak to public health officials relating to COVID-19 matters as well as contains additional information for tourists.

2.3.3.1. The App Engagement Process

Phase One: Downloading and Setup

Users can download *Rakning C-19* from the Google Play Store or the App Store.¹⁷ When the app is installed, individuals are asked to enter their phone number. Individuals will then receive a text message with a code that must be entered into the app. The user will then be asked whether they consent to giving the app access to their location data.

¹⁴ Ciric, J. (2020, March 26). Tracking app may assist Iceland with Coronavirus contact tracing. Iceland Review. Retrieved from <https://www.icelandreview.com/sci-tech/tracking-app-may-assist-iceland-with-coronavirus-contact-tracing/>

¹⁵ Rakning C-19. (2020). Google Play. Retrieved from https://play.google.com/store/apps/details?id=is.landlaeknir.rakning&hl=en_CA&gl=US; Rakning C-19 (2020). App Store. Retrieved from <https://apps.apple.com/ca/app/rakning-c-19/id1504655876>

¹⁶ Government of Iceland. (2020). Tracing app Rakning C-19. Retrieved from <https://www.covid.is/app/en>

¹⁷ Ibid.

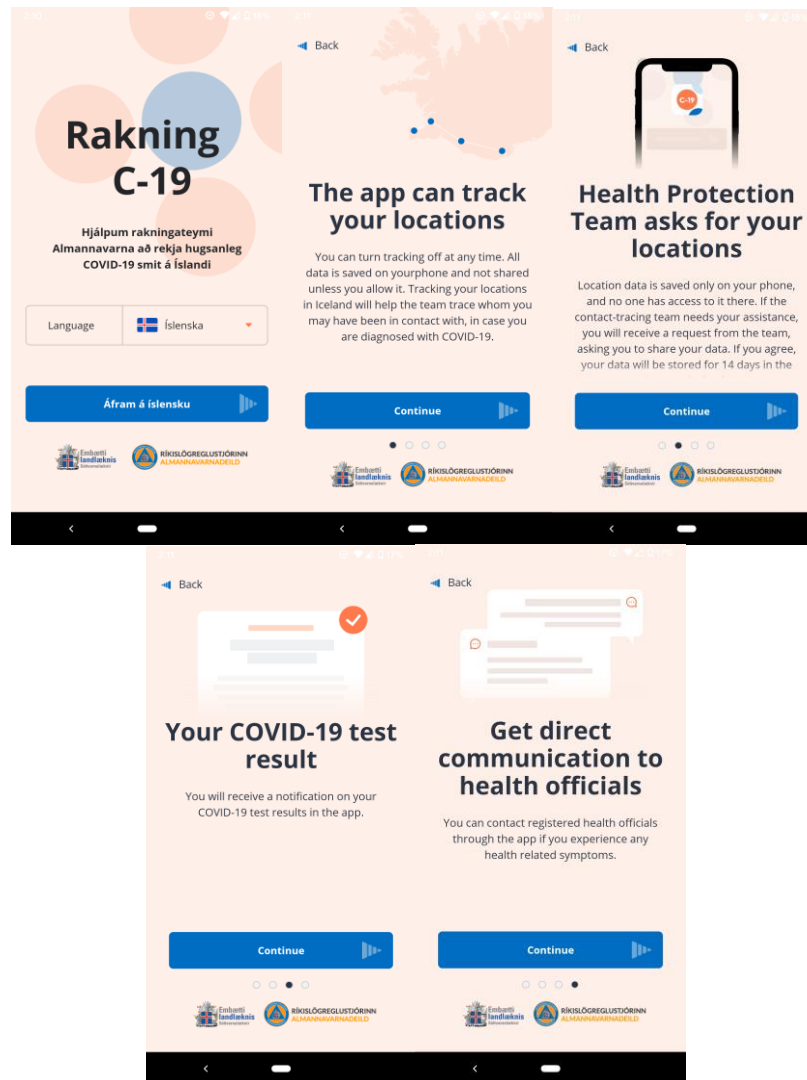


Figure 2.2.0. Initial *Rakning C-19* Set-Up Screen Images¹⁸

Phase Two: Usage

For the app to function, individuals need to allow the app to have access to location data. *Rakning C-19* works by registering users' GPS data to create a record of where individuals have traveled. The app runs in the background, saving location information several times per hour. The app does not need to be specifically opened in order to work and will run when other apps are being used. The website notes however, it may be a good idea to open the app briefly when departing home as the app may sometimes stop working in the background.

¹⁸ Rakning C-19. (2020). Google Play. Retrieved from Retrieved from https://play.google.com/store/apps/details?id=is.laeknir.rakning&hl=en_CA&gl=US

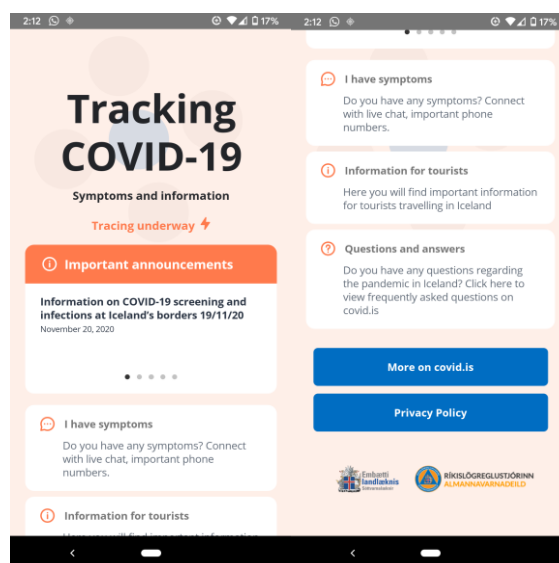


Figure 2.3.0. How *Rakning C-19* Looks Once Downloaded and Tracking is Activated¹⁹

Phase Three: Reporting

Individuals who have tested positive for COVID-19 and use *Rakning C-19* will receive a request in the app from the Department of Civil Protection and Emergency Management's Contact Tracing Team asking them to share their location data.²⁰ Individuals can consent by entering their national ID number. Sending location data can help the contact tracing team get a more accurate idea of all the locations the person has visited. This location data can help the contact tracing team identify locations where transmission and potential exposure may have occurred.

Part Four: Reacting

Under the current version of the app, individuals do not receive notifications about potential exposure based on their location data because only data from individuals who test positive for COVID-19 and consent to share their data are available to the contact tracing team. As previously noted, the new app that may be introduced will address this limitation by providing exposure notifications through relying on Bluetooth technology.

¹⁹ Rakning C-19. (2020). Google Play. Retrieved from Retrieved from https://play.google.com/store/apps/details?id=is.landlaeknir.rakning&hl=en_CA&gl=US

²⁰Government of Iceland. (2020). Tracing app Rakning C-19. Retrieved from <https://www.covid.is/app/en>

2.3.4. App-Uptake

2.3.4.1. Uptake Summary

Table 2.2.0: *Rakning C-19* Uptake Summary

	Iceland
Uptake (#downloads)	~136,000 ^{21*}
Uptake (active users)	Data could not be found
General Uptake (# of downloads general population)	~40% ²²
Age Appropriate Uptake (# of downloads / people over age allowed to download)	Data could not be found
Digital Uptake (# of downloads / connected population)	Data could not be found
Digital Capability Uptake (# of downloads / app-compatible population)	Data could not be found

2.3.4.2. Uptake Description

With a population of 341,947, roughly 40% of Iceland's population downloaded *Rakning C-19*, reportedly one of the highest penetration of voluntary contact tracing apps in the world.²³ Within the first 24 hours, 75,000 people downloaded the app.²⁴ Reports of the high levels of download approaching 40% appeared within the first month of the app's release. Based on personal correspondence in October, it is evident that there may be close to 210,000 downloads but this estimate included downloads by tourists who would then delete the app when they leave Iceland.²⁵ Therefore, while the estimate that 40% of Icelanders downloaded *Rakning C-19* has not been updated since June 2020, it remains the best published estimate of the download rate among the Icelandic population. In terms of other percentages of different groups of uptake as defined in Table 2.2.0, no data could be found. It is important to note that, as mentioned in Module 1, Section 1.5, there are significant issues with determining app success via uptake percentages.

²¹ Big brother knows and still Icelanders are happy. (2020, April 23). United Nations Regional Information Centre for Western Europe. Retrieved from <https://unric.org/en/big-brother-knows-and-still-icelanders-are-happy/>;

*Personal correspondence in October 2020 suggested there has been close to 210,000 downloads of Ranking C-19, but this estimate includes tourists who then delete the app.

²² Law Library of Congress, Global Legal Research Directorate. (2020, June). Regulating Electronic Means to Fight the Spread of COVID-19. Retrieved from <https://www.loc.gov/law/help/coronavirus-apps/iceland.php>

²³ Johnson, B. (2020, May 11). Nearly 40% of Icelanders are using a covid app—and it hasn't helped much. MIT Technology Review. Retrieved from <https://www.technologyreview.com/2020/05/11/1001541/iceland-rakning-c19-covid-contact-tracing/>; Worldometer. (2020). Iceland Coronavirus Cases. Retrieved October 24, 2020, from <https://www.worldometers.info/coronavirus/country/iceland/>

²⁴ National Crisis and Coordination Centre. (2020, April 3). *Status report: Coronavirus- COVID-19* [Press release]. Retrieved from <https://www.almannavarnir.is/english/pandemic-influenza/influenza-a-h1n1/>

²⁵ Personal communication, October 9, 2020

2.4. Uptake Factors

2.4.1. Summary of Uptake Factors

Table 2.3.0: Summary of Uptake Factors in Iceland

Factor	Micro, Meso, and/or Macro	Brief Description
Sense of Community	Meso	The Icelandic government has described their COVID-19 strategy as a “collaborative model” with citizens, residents, and tourists, opting to trust these groups to follow guidelines.
Trust in Public/Private Institutions	Macro	People in Iceland are reported to have high levels of trust in government officials to take appropriate measures to respond to the pandemic.
Policy & Governance	Macro	The privacy policies of the app are publicly available and easily understandable.
Response Infrastructure	Macro	As a nation that regularly faces emergencies (e.g. earthquakes), there is existing infrastructure to manage emergency responses. There were similarly quick and efficient responses to mobilize health infrastructure to respond to the pandemic (e.g. expansion of testing capacity and investment in aggressive manual contact tracing efforts).

2.4.2. Factor Descriptions

2.4.2.1. Sense of Community

Iceland has been described as a country that is socially cohesive with “strong social networks.”²⁶ The government’s approach to limiting the spread of COVID-19 has capitalized on this strong sense of community; their approach has been described as a “collaborative model” with citizens, residents, and tourists.²⁷ They opted to put trust in these groups to follow the guidelines rather than heavily relying on fines and laws. This shared trust between the government and citizens, residents, and tourists allowed Iceland to avoid full national lockdown.²⁸ Authorities indicated that Icelanders were following social distancing requirements and thus guidelines functioning largely on trust were successful.

Additionally, the website launched by the Iceland government for *Rakning C-19* indicates the more people who download the app, the more useful information analyzed from it will be, and asks people to “be a strong link in the chain.”²⁹ This highlights the strong emphasis placed on every individual doing their part to protect the community from the spread of COVID-19. The existing strong social connections and sense of civic responsibility among Icelanders may have allowed such messaging to strike a chord with citizens,

²⁶ A coronavirus test for anyone? In Iceland, it's happening. (2020, April 8). The Press Democrat. Retrieved from <https://www.pressdemocrat.com/article/news/a-coronavirus-test-for-anyone-in-iceland-its-happening/?sba=AAS>

²⁷ Johnson, B. (2020, May 11). Nearly 40% of Icelanders are using a covid app—and it hasn’t helped much. MIT Technology Review. Retrieved from <https://www.technologyreview.com/2020/05/11/1001541/iceland-rakning-c19-covid-contact-tracing/>

²⁸ Hjelmgard, K. (2020, April 10). Iceland has tested more of its population for coronavirus than anywhere else. Here's what it learned. USA Today. Retrieved from <https://www.usatoday.com/story/news/world/2020/04/10/coronavirus-covid-19-small-nations-iceland-big-data/2959797001/>

²⁹ Government of Iceland. (2020). Tracing app Rakning C-19. Retrieved from <https://www.covid.is/app/en>

residents, and tourists and contributed to the successful adoption of the app by a significant part of the population. Similarly, high levels of social interaction and trust among the community may increase the responsibility people feel to download and use the app to help safeguard the health of others as they expect others will act this way too.

2.4.2.2. Trust in Public/Private Institutions

People in Iceland are reported to have high levels of trust in government officials, including in the Directorate of Health and the Department of Civil Protection and Emergency Management, both of which were crucial in coordinating the government response to the COVID-19 pandemic.³⁰ The Icelandic government prioritized good communication during the pandemic response and conducted open and frequent communication to inspire the belief amongst its citizens, residents, and tourists that the government was taking appropriate action.³¹ During the height of the pandemic, there were daily press briefings described as just the facts, “no politics and no politicians in the way.”³² In addition, the government launched a COVID-19 website available in eight languages.³³ The high level of transparency seemed to successfully sustain high levels of trust in government – a Gallup poll reported a 96% approval rate among Icelanders of the response of Icelandic authorities to the pandemic.³⁴

Also likely contributing to high approval ratings was the government’s response respecting the Icelandic population’s high regard for scientific expertise.³⁵ Reflecting this belief, the government’s response has been described as allowing politicians to take a back-seat to medical experts who are leading the response. Science-focused strategic communication that is transparent and expert-driven has been suggested as a factor contributing to public cooperation with contact tracing and containment measures and this may be especially effective when it mirrors beliefs held by the population.³⁶

2.4.2.3. Policy & Governance

Transparency and privacy protection are factors that have been suggested to increase the willingness of people to download a contact tracing app.³⁷ Concern about the storage of data collected and lack of protections against the use of this data for purposes other than contact tracing may serve as barriers to app adoption. *Rakning C-19* has been recognized as one of the least invasive apps from a privacy perspective.³⁸ By having clearly laid out privacy policies, the *Rakning C-19* website makes the data storage

³⁰ NPR Weekend Edition Sunday. (2020, May 17). How Iceland handles contact tracing [Audio recording]. Retrieved from <https://perma.cc/EBW8-2QQZ>

³¹ Controlling and preventing infection spread in Iceland. (2020, July 23). Health Europa. Retrieved from <https://www.health.europa.eu/controlling-and-preventing-infection-spread-in-iceland/101614/>

³² Kolbert, E. (2020, June 1). How Iceland beat the Coronavirus. The New Yorker. Retrieved from <https://www.newyorker.com/magazine/2020/06/08/how-iceland-beat-the-coronavirus>

³³ Bishop, T. (2020, May 17). COVID-19 lessons from Iceland: How one Nordic country has all but stopped the virus in its track. GeekWire. Retrieved from <https://perma.cc/RKS6-LG4G>

³⁴ Askham, P. (2020, April 21). COVID-19 in Iceland: Tenth death, new government package announced. Grapevine. Retrieved from <https://grapevine.is/news/2020/04/21/covid-19-in-iceland-tenth-death-new-government-package-announced/>

³⁵ Hjelmgaard, K. (2020, April 10). Iceland has tested more of its population for coronavirus than anywhere else. Here's what it learned. USA Today. Retrieved from <https://www.usatoday.com/story/news/world/2020/04/10/coronavirus-covid-19-small-nations-iceland-big-data/2959797001/>

³⁶ Bhatia, D., Morales-Vazquez, M., Song, K., Roerig, M., Allin, S., & Marchildon, G. (2020). COVID-19 Case and Contact Tracing: Policy Learning from International Comparisons. Toronto: North American Observatory on Health Systems and Policies. Rapid Review (No.25).

³⁷ von Gratz, P. G. (2020, June 24). Pandemic management – room for improvement at ground control? Mobi Health News. Retrieved from <https://www.mobihealthnews.com/news/emea/pandemic-management-room-improvement-ground-control>

³⁸ Law Library of Congress, Global Legal Research Directorate. (2020, June). Regulating Electronic Means to Fight the Spread of COVID-19. Retrieved from <https://www.loc.gov/law/help/coronavirus-apps/iceland.php>

procedures and limitations on data use easily comprehensible. The *Rakning C-19* website indicates “location data are saved only on your phone, and no one has access to them there. If the nation’s contact tracing team needs your assistance in tracing contagion, they will send you a request and ask you to send them your data. If you agree, your data will be stored for 14 days in the Tracing Team’s Database.”³⁹ Additionally, the app is open source and has been approved by the Icelandic Data Protection Authority.³⁹ The clearly laid out policies may have contributed to high adoption rates because if people feel confident they understand how data is being collected and the limited purposes their data will be used for (avoiding fears of mission creep), they may be more willing to download and use the app.⁴⁰

2.4.2.4. Response Infrastructure

Iceland’s Director of Health, Dr. Alma Möller, described Iceland as “[...] a nation that’s used to catastrophes.”⁴¹ As a country with an emergency agency that has experience dealing with avalanches and volcanoes, their capabilities to respond to the new emergency of COVID-19 may have been superior to other countries with less experience with emergency response management. Comparatively, Iceland may have had existing legislation and public infrastructure in place allowing a fast and effective government response.⁴² For example, the National Commissioner of the Icelandic Police (NCIP) runs the Department of Civil Protection and Emergency Management which oversees a national command centre that operates during emergencies.⁴³ Furthermore, as stated by Prime Minister Katrín Jakobsdóttir, Iceland began preparing for the pandemic long before the first positive case in Iceland with widespread testing and discussing contact tracing plans.⁴⁴

Iceland’s speed of activating its response infrastructure was also reflected in the efficient adaptation of health infrastructure in response to the pandemic. Specifically, the government’s collaboration with private biotech company deCODE Genetics based in Iceland allowed Iceland to achieve one of the highest testing rates per capita early on in the pandemic.⁴⁵ Widespread testing began prior to the first positive diagnosis and free tests were available to the public. High testing rates meant Iceland was clearly informed of the incidence of the virus and could make informed judgements about restrictions necessary to contain the spread. Furthermore, prior to the introduction of the *Rakning C-19*, the government had

³⁹ Boudreaux, B., Denardo, M., Denton, S., Sanchez, R., Fiestel, K., & Dayalani, H. (2020). Data Privacy During Pandemics. RAND. Retrieved from https://www.rand.org/content/dam/rand/pubs/research_reports/RRA300/RRA365-1/RAND_RRA365-1.pdf

Bhatia, D., Morales-Vazquez, M., Song, K., Roerig, M., Allin, S., & Marchildon, G. (2020). COVID-19 Case and Contact Tracing: Policy Learning from International Comparisons. Toronto: North American Observatory on Health Systems and Policies. Rapid Review (No.25).

⁴⁰ Hamilton, I. (2020, May 12). Iceland had the most-downloaded contact-tracing app for its population size. Authorities there say it hasn’t made much difference. Business Insider. Retrieved from <https://www.businessinsider.com/iceland-contact-tracing-not-gamechanger-2020-5>

⁴¹ Kolbert, E. (2020, June 1). How Iceland beat the Coronavirus. The New Yorker. Retrieved from <https://www.newyorker.com/magazine/2020/06/08/how-iceland-beat-the-coronavirus>

⁴² Bhatia, D., Morales-Vazquez, M., Song, K., Roerig, M., Allin, S., & Marchildon, G. (2020). COVID-19 Case and Contact Tracing: Policy Learning from International Comparisons. Toronto: North American Observatory on Health Systems and Policies. Rapid Review (No.25).

⁴³ About the Department of Civil Protection and Emergency Management. (2020). Almannavarnir. Retrieved from <https://www.almannavarnir.is/english/about-the-department-of-civil-protection-and-emergency-management/>

⁴⁴ Kolbert, E. (2020, June 1). How Iceland beat the Coronavirus. The New Yorker. Retrieved from <https://www.newyorker.com/magazine/2020/06/08/how-iceland-beat-the-coronavirus>; Laurent, L. (2020, May 16). Iceland Is the Perfect Coronavirus Refuge. Bloomberg Opinion. Retrieved from <https://www.bnnbloomberg.ca/iceland-is-the-perfect-coronavirus-refuge-1.1437223>

⁴⁵ Law Library of Congress, Global Legal Research Directorate. (2020, June). Regulating Electronic Means to Fight the Spread of COVID-19. Retrieved from <https://www.loc.gov/law/help/coronavirus-apps/iceland.php>

invested resources in building a team of manual contact tracers.⁴⁶ Manual contact tracing provides nuanced information about interactions not captured by contact tracing apps (for example, if people were wearing masks during interactions). Thus, integrating manual and digital contact tracing efforts can lead to superior outcomes. The earliness and effectiveness of activating response infrastructure allowed Icelandic officials to make informed decisions which likely contributed to high levels of trust and approval of the government's response as well as likely increased willingness to follow government directives such as downloading the contact tracing app. Furthermore, it has been suggested that contact tracing apps are most effective when part of a broader healthcare response including widespread testing and access to healthcare.⁴⁷

2.5. Conclusion

With one of the highest download rates per capita for a voluntary digital contact tracing app, *Rakning C-19* has been an important part of Iceland's digital response to the pandemic. Within a month of its release, about 40% of the population had downloaded the app. Relying on GPS, the app creates a record of locations a user has traveled to, which can be shared with the contact tracing team if an individual tests positive for COVID-19. Sharing this location data can help the contact tracing team develop a more accurate understanding of locations an individual who tested positive for COVID-19 has traveled to and better pinpoint possible areas of exposure. In this way, *Rakning C-19* has been an important supplement to the manual contact tracing efforts in Iceland. The incorporation of digital contact tracing with manual contact tracing may have led to a more effective contact tracing system.

In general, Icelanders are reported to have high approval rates of effectiveness of the response of Icelandic authorities to the pandemic. This could be because authorities acted quickly to activate its response infrastructure and allowed medical professionals to lead the pandemic response which also sought to capitalize on high levels of a sense of community. Additionally, the government adopted a response that valued transparency and privacy protection which may have facilitated high levels of trust in government institutions. All these factors may have increased the willingness of the population to comply with government directives and download *Rakning C-19*. Advances in technology may allow digital contact tracing to take an increasingly important role in this pandemic, however, to be most effective, digital contact tracing apps cannot function alone, they must be a part of an overall efficient pandemic response plan.

⁴⁶ Johnson, B. (2020, May 11). Nearly 40% of Icelanders are using a covid app—and it hasn't helped much. MIT Technology Review. Retrieved from <https://www.technologyreview.com/2020/05/11/1001541/iceland-rakning-c19-covid-contact-tracing/>

⁴⁷ Browne, R. (2020, July 3). Why coronavirus contact-tracing apps aren't yet the 'game changer' authorities hoped they'd be. CNBC. Retrieved from <https://www.cnbc.com/2020/07/03/why-coronavirus-contact-tracing-apps-havent-been-a-game-changer.html>