Evaluation of Effectiveness of Digital GPS Contact Tracing Technology in Response to COVID-19

Louis S. Park[1,2]; Jasrita Singh[1,2]; Jilene Malbeuf, M.A.[1,3], and Austin A. Mardon, CM, Ph.D.[1,3*]

[1]Antarctic Institute of Canada, Edmonton, AB, Canada.
[2]McMaster University, Hamilton, ON, Canada.
[3]University of Alberta, Edmonton, AB, Canada.

E-mail: amardon@yahoo.ca*
singj15@mcmaster.ca
parkl9@mcmaster.ca

ABSTRACT

The unprecedented COVID-19 pandemic is threatening the health and lives of global civilians. Given the urgent need for spread prevention, governments have developed digital contact tracing technology for preventing the transmission of the virus. Despite its effective and efficient use in tracing active COVID-19 patients, several privacy concerns accompany the use of this technology. To overcome these limitations, possible improvements and intervention plans for implementing safe, digital contact tracing were proposed.

(Keywords: digital contact-tracing, COVID-19, quarantine, testing, data privacy, dilemma, decentralized system)

INTRODUCTION

COVID-19 is caused by the novel coronavirus (SARS-CoV-2). Governments have been working diligently to develop procedures and technology to monitor and control the spread of the COVID-19 outbreak. Many countries have taken unprecedented response measures—some evoking public controversy over privacy concerns.

Countries like South Korea have successfully used digital contact tracing technology using GPS data as a means to enforce quarantine regulations and testing of those who had been in contact with active COVID-19 patients (Servick, 2020). The exemplary epidemiological curves of these countries tend to demonstrate that the use of digital contact tracing technology could interrupt chains of contagion, resulting in lower transmission rates and the isolation of potential patients, thereby flattening the curve. However, there is much public controversy and concern over privacy protection and the malicious use of personal data (Rowe, 2020). Without evidence about the efficacy of GPS tracking, it is not possible to weigh the pros and cons of personal data usage.

This paper discusses the effects of digital contact tracing on the epidemiological control of COVID-19 in reference to international case studies. The special conditions and criteria for successful and effective practice of digital contact tracing are also discussed as well as limitations, concerns. and ethical dilemmas of digital contact tracing. Various modification plans for digital contact tracing are also highlighted, which could help minimize the risks of the technology and improve its efficiency in tracing active patients during the COVID-19 pandemic.

DIGITAL CONTACT TRACING

Digital contact tracing allows instant, real-time contact tracing of individuals who were in contact or in close proximity with a COVID-19 positive patient (Kleinman and Merkel, 2020). Using GPS location and the test result of a COVID-19 patient, individuals who were in contact with the patient are notified, advised to self-isolate, and get tested. Research suggests that live notifications through GPS contact tracing technology could be sufficient to stop the spread of a viral pandemic if it is used and implemented for the majority of the population––threshold of 60% of population—lowering the reproduction number (R_0) of COVID-19 to below zero ($R_0 < 1$)

and sustaining epidemic suppression (Ferretti, et al., 2020; Zastrow, 2020a).

Multiple versions of digital contact tracing technology are available. Countries such as South Korea and China have implemented involuntary data collection from GPS data to financial transactions, public transit uses, cell phone data, and security camera footages. Other countries in Europe have adopted an involuntary digital tracing instead, in the form of mobile apps with an option to opt out. Furthermore, in China, QR (Quick Response) codes were made available in public spaces throughout the city for citizens to scan, which allows authorities to log individual's visited locations (Kleinman and Merkel, 2020).

Furthermore, some contact tracing apps have opted to use Bluetooth for digital tracing. Instead of collecting users' GPS data, Bluetooth alerts users when a device is within a specific distance, *d* radius of the device of an active case (Kleinman and Merkel, 2020). This could prevent malicious use and surveillance of personal geographical data. However, since Bluetooth can be turned on and off and there may be delays in updating their COVID-19 diagnostic status, the app may not function effectively. It is also possible that "environmental factors could make a Bluetooth device that's 2 meters away appear to another device as if it's 20 meters away, or vice versa" (Biddle, 2020).

IMPACT OF DIGITAL CONTACT TRACING ON COVID-19 TREND

South Korea

South Korea has earned international recognition for its immediate response, successfully containing the coronavirus and maintaining daily new cases below 50 from 850 cases per day in March (Dong, Du, and Gardner, 2020). The country's success criteria relies on extensive testing and the widespread use of contact-tracing technology. On top of this, Korea integrated security cameras, cell phone geolocation data, and financial transactions, which created a detailed record of an infected individual's past movements and location history (COVID-19 National Emergency Response Center, 2020).

Thus, all Koreans with a smartphone automatically receive an alerting message when they are near a confirmed case of the coronavirus. The message describes the location, time and distance from the confirmed case and provides further instructions, which vary from two-week quarantine orders, or an immediate report to the nearest testing facility for COVID-19 testing. In addition, using the contact-tracing technology, the governments notify the confirmed cases' recent routes, allowing them to avoid specific locations where an active case has been found (Zastrow, 2020b).

United States of America

The United States is the most severely hit country in the world, with nearly 6 million COVID-19 cases (Dong, Du and Gardner, 2020). The United States has rejected the implementation of GPS contact-tracing technology. Thus, despite similar measures taken to South Korea including drive-thru testing, performing more than 2238 testing per million, and quarantine and shut-down measures, the numbers remain high (Roser, Ritchie, Ortiz-Ospina and Hasell, 2020). While the number of testing performed is critical, knowing who to prioritize for testing is equally integral. This is especially important in the beginning phase of a pandemic, wherein the testing devices are still erroneous and limited in number. Moreover, according to the World Health Organization (WHO), about 80% of COVID cases are asymptomatic (World Health Organization, 2020).

Research further shows that identification and isolation of asymptomatic patients cannot be accurately determined and that they are not discovered until after one of their close contacts have been diagnosed (Tan, et al., 2020). Hence, given the United States' lack of digital contact tracing technology, identifying and testing potential COVID-19 patients would be made more difficult, thus leading to a greater spread of the virus. This would blind health officials on knowing who to test with priority, and quarantine, which otherwise could have mitigated the situation and lowered the numbers of COVID-19 cases.

Even outside of South Korea, there is evidence of contact-tracing apps being used successfully in countries such as Australia, China, and Singapore (Kleinman and Merkel, 2020). These countries that have implemented digital contact tracing technology have observed a reduction in daily COVID-19 cases and an epidemiological decline in numbers (Dong, Du and Gardner, 2020).

LIMITATIONS OF DIGITAL CONTACT TRACING

While the contact-tracing technology proves effective in enforcing quarantine and testing, its privacy concern is a great drawback to its implementation in certain countries. As mentioned before, South Korea was able to use contact tracing effectively in conjunction with surveillance camera checks, transaction history, and public transit routes. The South Korean government's release of transparent and accurate information about the virus has gained public trust in regards to privacy concerns, which allowed contact tracing in South Korea to fully function and be effective (Zastrow, 2020b).

In fact, 86% of South Koreans answered that their government has done a "good job" at dealing with COVID-19 pandemic and that their country is more united, which is translated to public cooperation (Devlin and Connaughton, 2020). This reflects the level of trust in the government, and public cooperation that made digital contact tracing successful in Korea. However, in other countries where trust in the government and its transparency is relatively low, public sentiment to privacy will be more sensitive and cooperation will be limited. In such a case, digital contact tracing technology cannot be utilized to its full potential.

Contact tracing apps and technology relies on GPS signals and geo-location data of the users. With these data, identity theft, and breach of the user's medical history and other private information are made more vulnerable (Rowe, 2020; see also Burgess, 2020). In addition, the public fear of surveillance from its government, and monetization of personal and health data from technology giants cannot be negated either. This technology poses a privacy paradox wherein a dilemma evidently exists between "who and what to protect": privacy or safety from COVID-19 (Rowe, 2020).

Furthermore, La Quadrature du Net, a French advocacy group for digital data protection, argues that contact tracing technology may give a false impression to the citizens and deceive them to feel safe, and prevent them from behaving with caution (Rowe, 2020). In fact, given the current GPS technology, it is only accurate to about 7-13 m, which indicates that contact tracing—by itself—may not function and alert effectively inside a building or compact room of people (Merry and Bettinger, 2020). In addition, this technology may confuse the tracking and management of COVID-19 cases as people might hide their symptoms to avoid public discrimination (Rowe, 2020).

WAY FORWARD FOR DIGITAL CONTACT TRACING

To ensure and maintain the efficacy of contact tracing technology in response to future pandemics, privacy concerns and its efficacy must be addressed and enhanced.

First, a decentralized system can be adopted. A decentralized contact tracing system, proposed by Apple and Google, include storing personal data on individual phones rather than a cloud, thereby preventing the formation of one large database (Kleinman and Merkel, 2020). This would reduce the efficiency of digital contact tracing, however.

Second, an integration of digital contact tracing to traditional human-labor tracing methods. As mentioned before, in the case of South Korea, digital contact tracing apps first detected contact, which allowed rapid and automatic screening, thereby saving time. Then, each case was verified and cross-referenced manually using medical records, transaction time and location, surveillance cameras, and public transit routes (Kleinman and Merkel, 2020). This improvement would greatly increase the efficacy of contact tracing.

Third, encryption of personal GPS data. Data encryption translates data into another form of representation, or codes. Encrypted data requires a decryption key or a password, which is only available to specific individuals of choice, to be decoded and read. This could ensure the privacy of users from external sources or malicious hacking.

Fourth, strengthened legal frameworks and consequences on a federal level may be implemented. There must be more strict legal consequences for release and manipulation of private data, in conjunction with an increased investment for an improved governmental digital police team. This high level of legal punishment and likelihood of being caught would allow civilian users to feel more protected under the law and would be able to deter potential cybercriminals (Johnson, 2019).

Finally, in order to ensure maximum efficiency of digital contact tracing technology, high testing capacity must be achieved by the country. When individuals are detected via tracing and until they are tested, they are only *potential* active cases. Therefore, to allow for accurate identification and management of COVID-19 cases, the rate of testing should ideally match or exceed the rate of detection.

CONCLUSION

The contact tracing technology has proved its efficiency and efficacy in regulating and slowing down the spread of the virus in many countries around the world. For governments considering implementation of digital contact tracing technology, its potential advantages as well as the privacy concerns must be weighed upon each other. The operating system used to acquire GPS data should be kept decentralized and encrypted, be combined with the traditional method of contact tracing for increased accuracy, and more strict legal jurisdictions should be set.

While digital contact tracing allows for quick and easy detection of active cases and potential carriers, civilian participation, transparency of government, and high testing capacity should be accompanied in order to ensure its success, protection of personal data, and mitigation of its limitations.

REFERENCES

1. Biddle, S. 2020. "The Inventors of Bluetooth Say There Could Be Problems Using Their Tech for Coronavirus Contact Tracing". *The Intercept*. https://theintercept.com/2020/05/05/coronavirus-bluetooth-contact-tracing/.

2. Burgess, M. 2020. "Coronavirus Contact Tracing Apps were Meant to Save Us. They Won't". *WIRED UK*. https://www.wired.co.uk/article/contact-tracing-apps-coronavirus.

3. COVID-19 National Emergency Response Center, Epidemiology & Case Management Team, Korea Centers for Disease Control & Prevention. 2020. "Contact Transmission of COVID-19 in South Korea: Novel Investigation Techniques for Tracing Contacts". *Osong Public Health and Research Perspectives*, 11(1): 60–63. https://doi.org/10.24171/j.phrp.2020.11.1.09

4. Devlin, K. and A. Connaughton. 2020. "COVID-19 Response Approved by Most in 14 Nations with Advanced Economies". Pew Research Center's Global Attitudes Project. https://www.pewresearch.org/global/2020/08/27/most-approve-of-national-response-to-covid-19-in-14-advanced-economies/.

5. Dong, E., H. Du, and L. Gardner. 2020. "An Interactive Web-Based Dashboard to Track COVID-19 in Real Time". *Lancet Inf Dis*. 20(5): 533-534. doi: 10.1016/S1473-3099(20)30120-1"

6. Ferretti, L., C. Wymant, M. Kendall, L. Zhao, A. Nurtay, L. Abeler-Dorner, … and C. Fraser. 2020. "Quantifying SARS-CoV-2 Transmission Suggests Epidemic Control with Digital Contact Tracing". *Science*. 368(6491). https://doi.org/10.1101/2020.03.08.20032946

7. Johnson, B. 2019. "Do Criminal Laws Deter Crime?". *Deterrence Theory in ... Minnesota*. House Research Department . https://www.house.leg.state.mn.us/hrd/pubs/deterrence.pdf.

8. Kleinman, R.A. and C. Merkel. 2020. "Digital Contact Tracing for COVID-19". *Canadian Medical Association Journal*, 192(24). https://doi.org/10.1503/cmaj.200922

9. Merry, K. and P. Bettinger. 2019. "Smartphone GPS Accuracy Study in an Urban Environment". *Plos One*, 14(7). https://doi.org/10.1371/journal.pone.0219890

10. Roser, M., H. Ritchie, E. Ortiz-Ospina, and J. Hasell. 2020. "Coronavirus Pandemic (COVID-19)". Published online at OurWorldInData.org. Retrieved from https://ourworldindata.org/coronavirus.

11. Rowe, F. 2020. "Contact Tracing Apps and Values Dilemmas: A Privacy Paradox in a Neo-Liberal World". *International Journal of Information Management*. https://doi.org/10.1016/j.ijinfomgt.2020.102178

12. Servick, K. 2020. "Cellphone Tracking could help Stem the Spread of Coronavirus. Is Privacy the Price?". *Science*. https://doi.org/10.1126/science.abb8296

13. Tan, J., S. Liu, L. Zhuang, L. Chen, M. Dong, J. Zhang, and Y. Xin. 2020. "Transmission and Clinical Characteristics of Asymptomatic Patients with SARS-CoV-2 Infection". *Future Virology*.

15(6): 373–380. https://doi.org/10.2217/fvl-2020-0087

14. World Health Organization. (WHO). 2020. “Coronavirus Disease 2019 (COVID-19) Situation Report–46”. Retrieved from https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200306-sitrep-46-covid-19.pdf?sfvrsn=96b04adf_4#:~:text=For%20COVID%2D19%2C,infections%2C%20requiring%20ventilation.

15. Zastrow, M. 2020a. “Coronavirus Contact-Tracing Apps: Can they Slow the Spread of COVID-19?”. *Nature*. https://doi.org/10.1038/d41586-020-01514-2

16. Zastrow, M. 2020b. “South Korea is Reporting Intimate details of COVID-19 Cases: Has it Helped?”. *Nature*. https://doi.org/10.1038/d41586-020-00740-y

ABOUT THE AUTHORS

Louis Park, is a student in the Faculty of Health Sciences at McMaster University, Hamilton. His research interests are in health policies and prevention and risk factors of cardiovascular diseases.

Jasrita Singh, is a student in the Faculty of Health Sciences at McMaster University, specializing in Biomedical Discovery and Commercialization. Her research interests are in translational medicine and synthetic biology.

Jilene Malbeuf, is a recent graduate from the University of Alberta with a Master of Arts degree in Classical Languages. Her focus is on Ancient Greek Literature and Philosophy, and in particular the Homeric dialect.

Austin Albert Mardon, Ph.D., CM, FRSC (University of Alberta), is an Adjunct Professor in the Faculty of Medicine and Dentistry at the University of Alberta, an Order of Canada member, and Fellow of the Royal Society of Canada.

SUGGESTED CITATION

Park, L., J. Singh, J. Malbeuf, and A.A. Mardon. 2020. “Evaluation of Effectiveness of Digital GPS Contact Tracing Technology in Response to COVID-19”. *Pacific Journal of Science and Technology*. 21(2):341-345.

Pacific Journal of Science and Technology