




COVID-19 Contact-Tracing Technology: Acceptability and Ethical Issues of Use

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Background: The contact-tracing COVID-19 technology allows for tracing people that come in contact to individuals with COVID-19 wherever they are located. The number of tracing COVID-19 infection technology and devices is rapidly increasing. This has prompted many researchers to study the acceptability and ethical issues related to the implementation of such technology.

Aim: The purpose of this study was to determine the acceptability of COVID-19 contact-tracing technology and ethical issues of use.

Methods: A cross-sectional questionnaire-based study was used. The target population was Jordanian adults (>18 years). The survey was distributed to a convenience sample of 2000 general public in Jordan.

Results: The results found that the number of people who accept to use COVID-19 contact-tracing technology was 71.6%. However, the percentage of people who were using this technology was 37.8. The main ethical concerns for many of participants were privacy, voluntariness, and beneficence of the data. Only income and living area were predictors for acceptability and use of tracing technology ($p \leq 0.01$).

Conclusion: The majority of Jordanians accept the implementation of contact-tracing technology for COVID-19 infection. Among ethical concerns of the implementation of such technology were privacy, beneficence and voluntariness.

Implications: The results of this study would help in improving the state of science regarding acceptability to use contact-tracing technology for health purposes. Moreover, the present findings provide evidence of predictors of acceptance and ethical concerns among Jordanian population about COVID-19 contact-tracing technology.

Keywords: research, ethical issues, individuals, Jordan, tracing COVID-19

Introduction

The coronavirus SARS-CoV-2 disease (COVID-19) is the most current threat that challenges health and economic sectors in the world. The impact of this infection continues to rise, affecting more individuals every second, with deaths estimated to reach 40 million if untreated.¹ One of the most effective ways to decrease the spread of this infection is tracing the primary and secondary contacts of confirmed COVID-19 cases using contact-tracing technology and devices. China has been very successful at controlling the spread of COVID-19 using this tracing technology.¹⁻³ Given the pressing need for expanding COVID-19 infection tracing option to other developing countries,¹ there is great enthusiasm for using such technology using smart phones, and devices for preventing the spread of the disease and making therapy more accessible. Thus, the number of COVID-19 infection

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tracing technologies has rapidly increased. They now include proximity tracking tools that use location-based (GPS) or Bluetooth technology to trace the movements of individuals to determine people who may have been exposed to an infected person. Other technologies such as characteristic tracking tools collect self-reported signs and symptoms to assess severity or the probability of infection due to COVID-19. These tools may also be helpful when integrated into the contact-tracing process.

Among the countries that implanted COVID-19 infection tracing technology is Singapore, which developed a mobile-based application called “Trace Together”, that could help responsible healthcare professional to trace and identify infected individuals and who exposed to them.⁴ Similarly, in Israel, the government obligates all citizens to download a mobile application to track the infected people and their contacts.⁵ In Western countries, such as the United States and United Kingdom, telemedicine technology using mobile applications was expanded to include COVID-19 to limit the spread of the virus.^{6,7} In Jordan, the Ministry of Health has announced new initiatives to trace the COVID-19 infection using “Aman” mobile application and bracelet tracking devices.

While the COVID-19 infection tracing technologies might be beneficial in limiting the spread of the virus, there is a concern by some individuals that these applications can have access to other personal information in the users’ smart mobiles.⁸ Furthermore, while safety and effectiveness are important issues, increased regulation for COVID-19 tracing technology did not address other important ethical challenges such as privacy and informed consent. In developed countries, the use of such technologies could fall under regulations concerning the protection of personal data, informed consent, as well as use of health technology and devices, which are well established.⁹⁻¹² However, no universal guidelines exist to ensure quality of these tracing technologies and applications to a gold standard. Moreover, many of the ethical challenges concerning tracing COVID-19 infection are rooted to human rights issues.³ Therefore, the purpose of this study was to determine the acceptability of COVID-19 contact-tracing technology and ethical issues of use in Jordan as an example of developing countries.

Methods

A descriptive cross-sectional design was employed through an online survey that was distributed during July 2020 using Google forms. The study was advertised

using social media and emails. The study survey was distributed to a convenience sample of 2000 general public in Jordan. Inclusion criteria were being at least 18 years old read and write in Arabic fluently. A total of 1654 individuals agreed to participate in the study (response rate was 83%). The targeted individuals were requested to willingly participate in the research by filling the consent form in the first electronic page of the survey. Once filled, the study participant was allowed to fill out the complete online questionnaire.

The instrument included four domains. The first domain collected demographic information such as age, gender, income, education. The second domain asked about acceptance and use of COVID-19 trace technology (4 items). The third domain was about the components and description of objective, instillation, management, and benefits for the users of COVID-19 tracing technology (10 items). The fourth domain included statements reflecting the general ethical issues related to use of the technology (10 items). The instrument of the study was developed by the authors and verified for validity and reliability among the general public, with an internal consistency of 0.77.

To review the content, face, and construct validities for the instrument, a pilot study was conducted before the actual research. The face validity was first checked by several colleagues who reviewed the draft of the questionnaire. The associates were requested to provide their take on clarity and question accuracy. The questionnaire was then adjusted according to their suggestions. Later, to guarantee participants understanding what the questions required, the verbal protocol was used to validate the questionnaire further. This involved separately recruiting ten respondents and requesting them to complete the questionnaire. The respondents were requested to think aloud, and to explain what each of their answers meant, and what each question meant to them. The researchers recorded each of their answers, where the questionnaire had an appropriate adaptation. The final version of the instrument will be provided to interested individuals upon request from the corresponding author.

Ethical Considerations

This study approved by Jordan University of Science and Technology’s IRB (approval ID: 2020339). Participants received an electronic consent form. The questionnaire was anonymous and thus no personal information/identification data were collected. The questionnaire required between

15–20 minutes to fill and no incentives were offered to participation. On the cover page of the questionnaire, the objectives of the study were explained. In addition, a statement that indicates the anonymity of the questionnaire and that no personal information will be collected was included. The collected information was stored in secure laptop and only the research team had an access to the data.

Data Analysis

The authors used SPSS version 23 to analyze the results of the study. Only completed questionnaires were analyzed. Descriptive statistics were employed for demographic characteristics such as gender, income, education. Moreover, acceptability and ethical consideration were analyzed using means and percentages. Multiple regressions test was used to determine the predictors of acceptability and use of tracing technology.

Results

Demographic Variables

The total number who agreed to participate was 1654 individuals. The number of females was 1056 (63.8) and the number of males was 598 (36.2). The mean age = 29.5 (SD=7.7). See [Table 1](#)

Acceptance of Use

The number of people who indicated they will accept to use this technology was 71.6%. Only 37.80% were current users of this technology. Additionally, 70% of participants indicated that they usually read the privacy instructions before using such a new technology. Moreover, most of the participants agreed that the community should regulate this technology (82.3%) (see [Table 2](#)).

Information for Users Regarding COVID-19 Tracing Technology

There are a number of issues that need to be taken into consideration when applying such a new technology. They included the objective and description of the technology 96.1%, how it works 92.3%, sponsors of this technology 80.2%, potential burdens 80.2%, possible benefits 88.2%, expected required time 84%, any type of incentives for use 83.6%, and the voluntariness for using such technology 84.5%. Regarding the best description of utilization of this technology, participants indicated that it is intended to monitor infection among people 74.1%, monitor people and gather their information 14.10%, and for scientific

Table 1 Demographic and Work Characteristic of Study Participants (N = 1654)

Variables	Category	N	%
Gender	Male	598	36.2
	Female	1056	63.8
Income	Less Than 700	1081	65.4
	700 To 1400	424	25.6
	More Than 1400	149	9.0
Living area	City	941	56.9
	Village	713	43.1
Work Place	Governmental institution	375	22.7
	Private entity	951	57.5
	Not Working	328	19.8
Level of education	Less Than high school Diploma	235	14.2
	Associate Degree	164	9.9
	Bachelor	730	44.1
	Higher Degree	525	31.7
Income (JDs)	Less Than 700	1081	65.4
	700 To 1400	424	25.6
	More Than 1400	149	9.0
Do you read privacy policy	No	496	30.0
	Yes	1158	70.0
Would you accept using COVID-19 tracing technology	No	470	28.4
	Yes	1184	71.6
Do you currently use any of the COVID-19 tracing technology	No	1029	62.2
	Yes	625	37.8
Do you think that the community need to be responsible about regulating COVID-19 tracing technology (JD=1.5 \$)	No	293	17.7
	Yes	1361	82.3

research 11.8%. Regarding who could have access to data collected by such a tracing technology, most of the respondents agreed that the World Health Organization 85.6% and COVID-19 technology tracing software companies 82.2% should have such access. However, many participants disagreed that people who used or download technology 79% to be allowed to control or manage this technology.

Table 2 Response to Who Should Reach the Information Gained from COVID-19 Contact-Tracing Technology

Items	No		Yes	
	Count	Row n %	Count	Row n %
1. Individuals who respond to trace COVID-19 infection	325	19.9%	1312	80.1%
2. Those who run COVID-19 infection tracing technology	442	27.0%	1194	73.0%
3. Those who financially support COVID-19 Infection tracing Technology	675	41.5%	953	58.5%
4. Communities in which COVID-19 infection tracing technology is performed	511	31.3%	1122	68.7%
5. Government/public sector	314	19.3%	1316	80.7%
6. The private sector*	643	40.5%	946	59.5%
7. COVID-19 infection technology software companies	547	33.7%	1074	66.3%
8. International destinations (such as WHO)	493	30.4%	1127	69.6%

Note: *Private sector in Jordan means non-governmental institutions and establishments.

When asked about who should have access to the information gained from COVID-19 contact-tracing technology? The highest agreement was on individuals who respond to trace the COVID-19 infection 80.1% and governmental sectors in general 80.7%, **Table 3**. Further, when asked about the benefits from the technology, the majority believed that this technology could decrease the rate of infection 74.6%, helps reach disadvantaged people 67.8%, give accordable data 68.8%, and are more efficient than other contact-tracing methods 48.8%.

Main Ethical Concerns

The participants of this study agreed that this technology may raise multiple ethical concerns such as privacy of information 88.6% and use of the collected information 82.5%, obligation of use of the technology 48.1%, and the clarity of conditions and privacy statements provided 42.1%, **Table 3**.

Predictors of Acceptability and Use of Tracing Technology

The multiple regressions test was used to determine the predictors of acceptability and use of tracing technology.

Table 3 Ethical Consideration for Using COVID-19 Contact-Tracing Technology

Consideration	No		Yes	
	Count	Row N %	Count	Row N %
1. Privacy of information	188	11.4%	1466	88.6%
2. Beneficence of information	289	17.5%	1365	82.5%
3. Voluntary participation	392	23.7%	1262	76.3%
4. Accessibility	336	20.3%	1318	79.7%
5. Technical problems with technology	406	24.5%	1248	75.5%
6. Legal problems	459	27.8%	1195	72.2%
7. The cost of participation	447	27.0%	1207	73.0%

The model was significant which means some factors may impact predictors of acceptability and use of tracing technology ($F= 4.37, p \leq 0.001$). These factors were income ($B= -.13, p \leq 0.001$) and area of living ($B=0.08, p=0.002$). This means only these two factors were predictors of acceptability and use of tracing technology and other factors were insignificant ($p > 0.05$).

Discussion

During COVID-19 pandemic, governments and private institutions have been depending on location, health, and population data to understand the rates of infection, the efficiency of social distancing directives, and factors of disease transmission.¹²⁻¹⁴ These institutions must ethically, robustly and transparently use this data to avert mass skepticism, violation of privacy rights, and the possible establishment of a dictatorial police after COVID-19 outbreak.

Technology Acceptance

Our contribution to the understanding of COVID-19 tracing technology adoption offer benefits at both personal and societal levels. The multi-faceted benefits of such technologies were providing the location and contact information of an individual to trace COVID-19 cases. The results of this study showed that more than 70% of people would accept using this technology. This indicates positive attitudes of Jordanians regarding the implementation of such technology for the control of COVID-19 spread. However, only 37.5% of participants were current users

of this technology. Thus, more motivation of people to download such applications is needed, probably, using governmental channels and media. The acceptance rate reported in this study is similar to that reported in other countries such as China and Singapore.^{16,18}

About one third of the sample of this study indicated that they would not accept using this technology. According to White & Peloza,¹⁴ suggestions from past research indicate that the usefulness of self-gain attraction can fail in situations where individuals can be made responsible for not participating in the combined attempt, such as the case of tracing contact applications. The researchers determined that individual benefit did not inspire installation, whether as a unique attraction (based on past research) or in combination with a societal-gain attraction (an extension of an earlier research).¹⁴ During pandemics, the appeals of benefits are only useful if they favor the altruistic and combined effort-centered concerns of the citizens.¹⁵⁻¹⁷ The COVID-19 pandemic could expedite the approval of these steps that the public would reject under normal circumstances. If this technology is applied in a manner that lowers infections and, consequently, the number of deaths, it may have a widespread application acceptance from the public. Nevertheless, enforcing such a technique at a large scale exposes very cloudy moral challenges about which type of monitoring technology is unreasonable.^{15,16} In the pandemic risk context, individuals may consider it necessary for their governments to implement techniques to monitor the spread of the outbreak and possibly manage it.

Concerns About COVID-19 Tracing Contact Application

One of the most agreeable points for more than 80% of the participants in this study was regarding the lack of information about COVID-19 tracing contact application such as objectives, description of the application, how it works, sponsors of this technology, potential burdens to use, possible benefits, and the voluntariness for using such technology. This was consistent with Hui and Mello studies, which found that most people were concerned and even, searched for a complete description of COVID-19 tracing contact application.^{18,19}

Extensive, refined, and mandated guidelines that stress the steps to be followed after data gathering, data utilization, and analysis are critical and should accompany any guidance to be deemed authoritative regarding COVID-19 virus data utilization.^{16,20} Next, the researchers must

enforce mechanisms of contacting the citizens after collecting and analyzing their data. Such a means would allow the fostering of communication between the user and the provider of the data to have the answers concerning the utilization of each data point.^{14,21}

Data Users,

Regarding who could manage and have access, the majority of participants agreed that WHO (85.6%) and COVID-19 software technology tracing software companies were the most important to have the access. It was previously reported that an effective collaboration between technology providers, and epidemiological health professionals would be the most productive effort to trace contacts and will need the collection of the least amount of data from users of smartphones.²²⁻²⁴ However, other studies found that users of smartphones may fail to participate because of fear or concerns those technology providers and/or, the government could utilize the technology in increasing monitoring measures even after the end of the pandemic.^{7,24}

The achievement of the technology will significantly rely on third-party organizations to ensure the privacy and safety of the citizens while using the contact-tracing app. To promote public confidence, users of smartphones should be informed that contact-tracing works without absolute location data utilization. It is evident that in this pandemic, world citizens may be compelled to share information that they do not usually share under normal circumstances to contribute to the protection of the global community's broader well-being. The elevated use of monitoring technology may be essential in saving lives during the pandemic.^{15,16}

Ethical Concerns

Multiple ethical concerns were raised during the pandemic related to the use of COVID-19 contact-tracing application. These concerns were beneficence (who benefit from the data), privacy, voluntariness and incentives. The present study found that beneficence of information was one of the concerns of most participants (82.5%). Regarding the benefits using this technology, current study participant indicated that COVID-19 contact-tracing technology could decrease the rate of infection, reach disadvantaged people, give accordable data, and have more positive effect than other non-technology-based methods. According to White & Simpson,²⁵ calls for benefits can be widely understood as appeals for measures that give reasons for embracing

individual conduct. The first concerns for participant was accepting to install the app because of their wants and needs, a choice facilitated by calculating cost-benefit.²⁶ Contrarily, according to White & Pelozo²⁷ and White & Simpson,²⁵ to the second concern alienating individual needs and prioritizing what others need, a choice prompted by the impetus to adhere to social expectations or altruism. Venkatesh et al²⁸ contend that the question of how users receive benefits when using an app influences approval and have been investigated in various fields, such as health technology.^{15,16}

Since such technology benefits the individual and the whole community, the decisions of well-informed citizens to install the app does not meet the usual motives of consumers and does not only promote the choice, but rather it instead reveals self-beneficial/prosocial conduct.^{25,27} Consequently, when it is time for policymakers to market the app, they must use benefit appeals in deciding which benefit(s) to highlight. The literature on sensitive data and privacy concerns informs this study by explaining how privacy design influences the acceptance of the app by users.^{29–32} Another major concern in this study for the participants was privacy and confidentiality. In our case, privacy is the right of people to keep their health and personal information private, whereas confidentiality refers to the duty to keep information of others private.³² It worth to mention that this application still have an access to all information that present in the phone such as pictures and social media that include sensitive information.

According to Bélanger & Crossler,³³ the privacy of information is when individuals can control the circumstances in which their details are gathered and utilized. The privacy design of an app can be different regarding the quantity and the kind of required sensitive details (for example, “data reduction”, that is strictly gathering what is essential) and the access control level (eg, “principle of information and reduced advantages”, i.e. the data repository and who accesses the data).³⁴ According to Malhotra et al,³⁵ since losing the privacy of information exposes users to various threats to confidentiality, they analyze the sensitivity of the information and the inability to control the information before releasing the details. For instance, mobile device and technology research has revealed how various designs of hardware affect privacy interest and user approval,²⁸ how clients opt for control to guide access of information,³⁶ and how the permission requirements of an app reduce the intention of installation.^{37,38}

Since issues of privacy are significant obstacles for app approval,³¹ it remains that the privacy design of an app

influences its adoption. For contact tracing to function, the app should access and analyze confidential information. A citizen’s decision to install an app would rely on how the app’s privacy is designed based on the sensitivity (for example, GPS tracing vs Bluetooth tracing) and monitoring (eg, centralized vs decentralized data processing; restricted vs extended data usage). It is upon the policy-makers to decide on the specification of privacy design that optimizes acceptance.

Voluntariness and Incentive

The least agreement in this study was if this technology should be obligatory (48.1%). The perfect circumstance would be the voluntary downloading of the app and a significant extent of a voluntary uptake of the app. This may be because it is assumed that acceptance of under 50% would still-combined with other methods-suffice in producing a significant effect.³⁹ There are various reasons why smartphone users will be highly motivated to take up the app. First, it would eventually imply that smartphone users and everybody else will quickly and safely emerge from the curfew. Secondly, by accepting the app, they will participate in saving the lives of other people, especially those at risk, and those providing care, both locally and internationally.

When the app’s adoption levels did not succeed, some authorities began using laws to mandate technology or making them a prerequisite for an individual to participate in public life fully. In the recent past, it may not be legally mandated to install an app and still consent-based,^{40,41} but consent will be meaningless if the benefit is too high for individuals to have the right to decide on using the app. Although international laws provide restrictions to civil rights during a public health emergency and privacy rights, it further explicitly defines how authorities should enforce such restrictions to harmonize privileges and avert misuses.

Currently, it is unclear whether implementing the suggested tools directly or indirectly would survive legal tests. Moreover, an approach that coerces is challenging if it does not recognize that many individuals may not access the internet or smartphones as assumption one shows. Despite these issues, India’s government made their contact COVID-19 tracing-contact technology compulsory for employees in the country and everyone in selected cities (this led to 90 million downloads, which accounted for less than 7% of the population). The quarantine app is compulsory despite its privacy issues.⁴²

In Singapore and Italy,⁴³ calls for mandatory use of technology are gaining momentum. In South Korea, foreigners are required to install a COVID-19 tracing-contact technology when they visit the country.⁴⁵ In Russia, Kazakhstan, and the Gulf states, while leaving the house during curfew, installing tracing technology is a prerequisite requirement.⁴⁶ It is crucial to evaluate the implementation of actors and practices to understand the real meaning of mandating in the lives of people. The police in India and Poland are tasked with implementing tools through fining or even sentencing to jail. In Russia, the quarantine app has inbuilt enforcement: failure to obey the app's instructions automatically leads to a fine, also if a virus in the bug causes this failure.^{40,41}

Furthermore, there are significant concerns about how individuals who do not own phones or the internet to abide by will perceive enforcement or how individuals whose economic circumstances compel them to leave their houses will view implementation.⁴⁰ Using incentives to increase the use of this technology educe may be valid if there were insufficient acceptance and that evidence existence that greater acceptance would protect more individuals. The kind of these incentives would call for keen evaluation through case-by-case. These may be some probable examples: donating to a selected charity or free credit for mobile phones.

A multiple regressions test was conducted to determine the predictors of acceptability and use of tracing technology. The results showed that only income and living areas were predictors for predictors of acceptability and use of tracing technology. This is expected since people living in cities are richer and open for technology and its implications compare to people living in rural areas.¹⁸

Limitations

There are many limitations in this study. In the web-based surveys, there is uncertainty over the validity of the data collected and sampling. Moreover, the opinions of illiterate people or those who had no internet cannot be cast. Finally, some of the terms used in the questionnaire such as "private sector" might be vague and thus may have biased the responses.

Conclusion

The contribution to the understanding of technology adoption offer benefits at both personal and societal levels using COVID-19 contact-tracing technology. However, the implementation of such technology may raise many ethical concerns including privacy, beneficence and voluntariness. The

acceptability to use contact-tracing technology for COVID-19 infection was high; yet, the actual use of the technology was comparably less. The results also showed that only income and living area were predictors of acceptability and use of tracing technology. Thus, healthcare providers and the government need to put more effort to promote actual use of tracing-contact technology for COVID-19 infection.

Author Contributions

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work".

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Disclosure

The authors report no conflict of interests for this work.

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