COVID-19 Contact Tracing: A Review on mHealth Application and HIPPA

Lorna Migiro, Hossain Shahriar, Sweta Sneha

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Lorna Migiro[1*] MSc; Hossain Shahriar[1*] DPhil; Sweta Sneha[1*] DPhil

[1]Kennesaw State University Department of Information Systems and Security Kennesaw US
[*]these authors contributed equally

Corresponding Author:
Hossain Shahriar DPhil
Kennesaw State University
Department of Information Systems and Security
Kennesaw
US

Abstract

Background: Contact tracing has been implemented as a necessary tool to slow the spread outbreaks over the years. During the COVID-19 pandemic, the introduction of digital applications has allowed a lot of flexibility regarding transmission by driving more people to testing and quarantine.

Objective: This study discusses contact tracing application usage in COVID-19, compare and analyze them based on HIPPA privacy rule. We also discuss challenges facing these new applications and recommend best practices.

Methods: The research sampled top ten applications currently in use. Using Android devices, we downloaded and interacted with apps that had over 100,000 downloads on google play store the way a normal user would. we reviewed their privacy policies and compared them against HIPPAs' privacy rule and generated a checklist.

Results: The study interacted and analyzed 10 contact tracing applications, particular attention was paid to how the apps' privacy policies and Google Play Store app privacy policy descriptions disclosed information.

Conclusions: Contact tracing applications have proved to be a fundamental pillar during this pandemic. Aligning this apps with the HIPPA privacy rule is one of the major challenges they face. Privacy concerns, user adoption and perception obstacles have also been associated with this apps. Clinical Trial: Not applicable.

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Lorna Migiro[1]; Hossain Shahriar[2]; Sweta Sneha[1]

1 *Kennesaw State University, Department of Information systems*

[2] *Kennesaw State University, Department of Information Technology*

Corresponding Author:
Lorna Migiro
Kennesaw State University
Department of information systems
lmigiro@students.kennesaw.edu

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Keywords- Contact tracing; COVID-19; HIPPA; Privacy rule; Security;

A. Introduction .

Outbreaks are a fact of life: In the 21st century, there were several large-scale disease outbreaks in human populations. Smallpox, Plague, severe acute respiratory syndrome (SARS) epidemic, H1N1, Ebola and Zika virus have all occurred as either epidermic or pandemic. COVID-19 was declared a global pandemic in March 2020 by World Health Organization. [1] Infectious disease outbreaks are closely linked to the community social fabric. These diseases majorly spread during the day-to-day social human interaction's activities [2]. "Contact tracing is a process that identify individuals who had close contact with a positive carrier, to determine whether one is infected or not" [1]. How this works is through a contact tracer, who interviews an infected person to get all the information on their whereabouts in the past 14 - 21 days [7]. Traditional contact tracing involves certain principles; first, a suspected case is reported to the surveillance system, then public health officer works with the case to trace back the steps one had taken for past 14 days when they may have been infectious. Lastly, the identified contacts are then notified to either quarantine or test and seek treatment [7, 8]. Similarly, technological advancements have made this process simple and manageable over the years. With Contact tracing apps, the process is now automated and more reliable, it is easier to identify contacts at risk. They leverage on smartphone Bluetooth and GPS for communication [16].

Contact tracing has been used as the standard tool for eliminating outbreaks over the years [26]. Extensive contact tracing helped to extinguish smallpox in 1979 and contain Ebola in Africa in 2014 [37]. In Europe, it was first implemented to contain the influenza Pandemic in 2009 and after the spread of Ebola into the UK in 2018 [3,4]. Contact tracing has also been used in other disease scenarios outside the pandemic perspective including HIV and Sexually transmitted infections (STI). In the care and treatment of STI, it is used to identify contacts of asymptomatic infections and those with slow transmission time scale [6]. Contact tracing has been very efficient in STI management because STI have low incidence rates and contact cases can easily be identified [7,10]. Airborne disease outbreaks like HINI, Severe Acute Respiratory Syndrome (SARS) or Middle East Respiratory Syndrome (MERS) are considered "fast course" with high transmission rates, contact tracing was less efficient in their containment [75]. Contact tracing is more efficient in the initial phases of a pandemic before other robust interventions like vaccines are developed. In addition to contact tracing, robust community mitigation measures and vaccination must be implemented for a successful control strategy [7,9].

Globally, digital contact tracing applications have been widely adopted in many countries to mitigate the spread of COVID 19. Covid Safe (AU) had over 5 million users download the app within two weeks of its initial release in Australia. Similarly, Aerogya Setu, from India has over 114 million downloads [59]. In the US, currently most states have adopted their own contact tracing apps majorly relying on the google/apple exposure notification system. New York's Covid Alert NY has been downloaded about 600,000 times since its launch, the state has over 2000 contact tracers who follow up individuals who test positive [59,62]. Pennsylvania Covid alert app had been downloaded more than 500,000 times [61]. According to Altmann et al, the number of downloads for an app is an indicator for user acceptability [73]. Contact tracing apps work best with increased local uptake, they may not stop the infection like COVID-19, but they do drive more people to testing and eventually slow down the spread. When one opts in, it uses Bluetooth service on a mobile device to track when a person comes in close proximity-six feet- with others using the same app. The phone exchanges a random secure code with another

phone to record its geo location. If a person tests positive and uploads their positive result, it notifies other app enabled users that were in proximity of the infected person for at least 10minutes. A daily summary report of all confirmed COVID-19 cases is available for comparison and display of COVID-19 alert [73].

Historically there has not been an outbreak like COVID 19 that required robust contact tracing efforts. As such experts estimate that at least 100,000 trained tracers are required for this process to be an effective control strategy [34.]
CDC is tasked with the development of guidance documents for any disease contact tracing including operational issues that relate to program implementation. It also provides technical guidance, both locally and global to all health departments launch effective contact tracing programs. HHS under Association of State and Territorial Health Officials Coordinates any National Approach to Scaling Public Health Capacity for Contact Tracing and Disease Investigation [11, 12].
Recent reviews have focused on COVID-19 and the technological aspect of contact tracing apps, to our knowledge none has discussed how contact tracing applications align with HIPPA privacy rule. This review hopes to foster more knowledge and understanding toward how Contact tracing apps can best be improved to ensure more privacy and maintain government standards.

B. LITREATURE REVIEW.

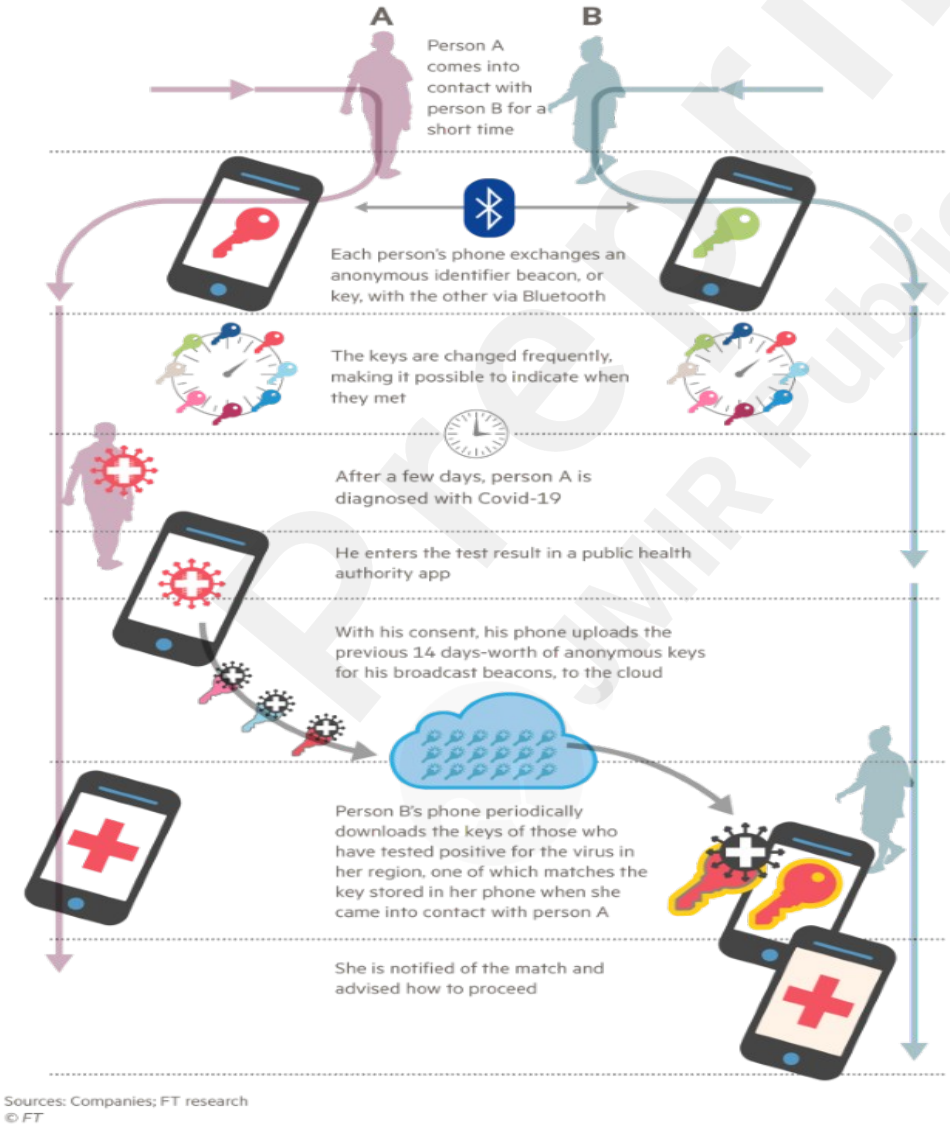
COVID-19 is a disease that develops due to infection with a type of coronavirus. Wuhan, China was the epicenter of this virus, before spreading internationally [13]. "COVID-19 is more infectious compared to other known viruses, not all carriers experience symptoms. During which they can spread the virus unknow willingly to those that encounter them [15,51]. "US Centers for Disease Control and Prevention (CDC) recognizes contact tracing as a fundamental pillar on how we intervene and prevent further spread of COVID-19" [15].
The process starts when Health authorities manually interview contagious individuals to collect information of contacts the infected person may have had in the past 14 to 21 days (identified as the incubation period for COVID-19) [7]. Data analysts then compute a risk-score for each contact identified basing on factors such as the duration and proximity to the contagious individual [7]. Manual contact tracing depends solely on how well a person can recall their past whereabouts and the people they have been in contact with. In addition, it requires a huge workforce for successful implementation [14].

Digital contact tracing on other hand substitutes individuals for more efficient mobile apps. Currently the two most promising technologies for tracking COVID-19 are through Bluetooth and GPS [16]. "Essentially Bluetooth is used to share data and connect to other nearby Bluetooth devices. While GPS uses signals to pinpoint a specific location at any time. The application then immediately alerts other users who were near the infected user, encouraging them to get tested" [17]. The mobile health applications are being used to provide updates on hotspots, guidelines, and ease healthcare systems [17]. The data gathered can help governments and public health associations find the best way to move forward especially now that people return to work and schools reopen. There is a growing demand for tools that can quickly find coronavirus risks.

In China, the use of mobile phones was a readily available resource used to track the spread of the coronavirus. "The Alipay Health app uses code to assign individuals green, yellow or red,

depending on whether they should be allowed into public spaces or quarantined at home" [20]. More than 200 Chinese cities have already implemented it, the ant Financial app leverages on big data to trace potential carriers [20,32]. Singapore and South Korea successfully used geo location together with credit card receipt tracking. The aim is to get more people driven to testing instead of quarantine which is seen as unpleasant option [21,52,54]. Quarantine has negative social economic impact on people especially without government incentives. The Swiss government incorporated a salary compensation scheme for every citizen that voluntarily quarantines when exposed.

Figure 1: Digital contact tracing [59].



One of the biggest roll outs during this pandemic is the joining of Apple and Google. They have

teamed up to develop a technology software that utilizes Bluetooth signals between smartphones to exchange information from mobile health apps [18]. Their design is compatible with all Google Android and Apple smartphones [33]. The exposure notification system is easily applicable in more places, thus been more adopted. The technology software contains application programing interfaces (APIs) and a system-level technology to support contact tracing through interoperability with Google and Apple devices [23].

European Union countries incorporated a decentralized interoperable approach, they only have to install one app for contact tracing [24]. Interoperable apps have since been rolled out successfully across the US, States Like Delaware and Pennsylvania and then New York and neighboring New Jersey Covid Alert app is inter - linked through a federated server uses google exposure notification system technology [22, 35]. As countries move toward reopening borders interoperable apps will allow app users to alert their close contacts anonymously if they have travelled to these regions.

Globally, scientists are collaboratively working to develop new innovations that are more current and tailored to the COVID 19 virus. REACT project is one such example. According to Emory University scientists, the REACT project is a real time app that not only tracks a user's location but also monitors the privacy risk. The app has potential to scale up contact tracing beyond the Bluetooth proximity tools [60]. Other new advancements that leverage on big data have also emerged. Digital epidemiology uses the readily available data from non-clinical settings for disease surveillance [25]. Public health entities leverage on the data to retrace one's movement for past 14-21 days. All the people that were in proximity are then notified to quarantine. This approach can provide the opportunity to collect data details that otherwise would not be possible. However, such technology impedes on privacy. Their looms fear of using such information for other purposes. In South Korea, similar technology has already been criticized for privacy an invasion on personal life [43]. Moreover, the question still looms whether Apple and google are best fit for the gate keeper's role in digital contact tracing. The success of digital epidemiology also depends on mass local community-wide involvement [18,34]. Without large involvement, the data gathered would be considered inconsistent or not complete. The importance of community-wide involvement is just one of the multiple keys to success. Across the globe, countries are putting efforts into rolling out various tracking applications for their communities [17].

The use of Smartphone applications features; location GPS and Bluetooth in contact tracing has indeed had a positive effect on the control strategy for spread of COVID 19. The process is scalable and efficient unlike traditional methods that solely relied on human memory. However, the technology utilization challenges in personal health information data exchange cannot be overlooked. Majority of entities are not covered by the HIPPA privacy rule; thus, privacy and centralization risks are of high concerns. However, Google and Apple have put measures that ensure that access of this information by public health authorities is only possible after voluntarily download and use the app by public [26,27]. The challenges of privacy and security of medical information will be discussed later in the paper.

C. HIPPA.

1) What is HIPPA?

"The Health Insurance Portability and Accountability Act of 1996" (HIPAA) is a federal law issued by The US Department of Health and Human Services (HHS) [57]. "HIPPA regulates the creation of national standards that protect sensitive patient health information from being disclosed without the patient's consent or knowledge" [56]. HIPAA has four main parts including Privacy Rule, Breach Notification Rule, Enforcement Rule, and Security Rule [57].

2) *Privacy Rule*

The Privacy Rule was enacted to ensure that personal health information (PHI) is properly protected during exchange and flow of health information all the while protecting the public's well-being [58]. The Privacy rule seeks to ensure sensitive patient information is well protected by "covered entities" [57].

The privacy rule defines permitted uses and disclosure of Patient Health Information (PHI) [58]. "A covered entity is permitted, but not required, to use and disclose PHI, without an individual's authorization" [58]. However, written authorization is mandatory for disclosure of PHI that is not for primary patient care except when it's for public interest and benefits national priority [57]. when such authorizations are granted, stringent Data Safeguards are required. A covered entity must make sure there is no Privacy Rule violation and Protected Data Leaking and disclosure

3) Covid 19 Contact tracing apps and HIPPA .

To mitigate and control the spread of the corona virus authorities must strike a balance between privacy protection visa vie the greater public health benefit. The public have a say in privacy enhancements that concern their personal health information. The role of HIPPA Privacy Rule is to protect the publics' personal health information as they seek care [58].

With COVID 19 who and when to share information is crucial. Its pertinent to notify close contacts to either seek quarantine or treatment whether one consents it or not. The HIPAA Privacy Rule allows "patient information to be shared to assist in nationwide public health emergencies, and to assist patients in receiving the care they need" [28]. In addition, the "Secretary of HHS may waive certain provisions of the Privacy Rule under the Project Bioshield Act of 2004 (PL 108-276) and section 1135(b)(7) of the Social Security" during a public health or other emergency [28]. However, one key challenge with digital contact tracing would be that many organizations that are a part of it, such as Google and Apple, do not fall into the category of covered entities and therefore do not have the same regulations to follow under HIPAA [29].

The protections that are guaranteed by HIPAA regulations would not be guaranteed for the protected health information that is shared in these apps. PHI is not given the same level of security, COVID-19 Consumer Data Protection Act was introduced to seal these loopholes. The general purpose of this act is to oversee and manage contact-tracing applications that are operated by institutions not under the Health Insurance Portability and Accountability Act (HIPAA) [28, 41]. Therefore, these companies are expected to show compliance and cooperation regarding their data collection and usage. It is also mandatory for these companies to seek individual approval and consent before collecting, processing, or transferring data collected

through their applications. The necessity of these options is to provide an individual's choices in which they would either agree or disagree with during data collection. Another requirement for Consumer Data Protection Act is that companies must discard all the personal information that is collected during the contact tracing process after usage. This is because once this information has served its health purpose, companies or individuals should not conserve this data for personal use [41]. Unfortunately, these regulations do not align with HIPAA since they only protect data in certain areas for users whereas they offer fewer to no level of data protection. It also does not seek consent from the patient to collect and save their medical data into the database [61]. Contrary to that, the act grants companies that are covered by it to implement consumer geolocation. This would also allow them to keep the information for personal reasons that do not serve the main agenda which is COVID-19 contact tracing. This becomes a vulnerability to the patient or client because this personal information could be sold or used for personal financial gains at their expense. Similarly, since this organizations are not liable under Health Insurance Portability and Accountability Act (HIPAA), their covered entities can easily obtain and disclose protected health information if the organization has sought voluntary authorization from all patients or contacts whose private information is within their database [30].

Based on the HIPPA privacy rule we summarize some questions for HIPPA checklist that we used to assess whether the top downloaded contact tracing apps in the US comply with HIPPA privacy rule.

1. *Does the app have a privacy policy?*
2. *Does the privacy policy clearly state what kind of information is collected by the contact tracing app?*
3. *Does the privacy policy explain how information collected will be used by the contact tracing application?*
4. *Do the privacy policy clearly state clients right to access personal information?*
5. *Does the right to access the personal information meet the requirement of the HIPAA privacy rule on permission and disclosure?*
6. *Can medical data be used for other purposes like performance evaluation or research?*
7. *Is the data stored by a third part?*
8. *Does the app provide a login process for the user to view and enter their data?*

Due to a lack of knowledge or being well informed, it is easy for an individual to assume that the Health Insurance Portability and Accountability Act (HIPAA) protection measures can be applied when it comes to applications that have been created to assist with remote contact tracing. These are many of the gaps as well as the challenges that have been detected in data collection and its analysis.

Contact tracing apps have emerged as a fundamental pillar in the fight against this pandemic. Effective implementation is what has kept public health system going as they seek better interventions against corona virus. Lessons learned from this pandemic have made systems smarter and well prepared for the next. We sought to analyze the contact tracing apps currently in use. particular attention was paid to how the apps' privacy policies and Google Play Store app privacy policy descriptions disclosed information. Using Android devices, we downloaded and interacted with apps that had over 100,000 downloads on google play store the way a normal user would. we reviewed their privacy policies and compared them against HIPPAs' privacy rule generated checklist and listed them in Table 2.

Table 1- The comparison of contact tracing apps with HIPPA checklist.

HIPPA Privacy checklist	CO exposure notification [64]	MD COVID Alert [65]	Care19[66]	Covid Alert NY [62].	MI COVID Alert [63]	Healthy together [68]	Slow covid NC [69]	Covid Alert PA [70]	Covid wise [71]	Guide safe [72]
Does the app have a privacy policy?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Does the privacy policy clearly state what kind of information is collected by the contact tracing app	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Does the privacy policy explain how information collected will be used by the contact tracing application	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Do the privacy policy clearly state clients right to access personal information	✓	✓	✓	✓	✓	✓	×	✓	✓	✓
Does the right to access the personal information meet the requirement of the HIPAA privacy rule of permitted use and disclosure principles?	×	✓	×	✓	✓	×	✓	✓	×	✓
Can medical data be used for other purposes like performance evaluation or research?	*NA*	✓	✓	×	✓	✓	✓	×	✓	×
Is the data stored by a third party?	NA	✓	✓	×	✓	✓	✓	✓	✓	×
Could user request to delete their information in this app?	✓	✓	✓	✓	✓	✓	✓	✓	✓	-✓
Does the app provide a login process for the user to view and enter their data	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

D. Result analysis

All Apps had a privacy policy, some of the privacy policies we interacted did not clearly state

the terms of how data is disclosed with third-party entities, four applications used template language borrowed from other privacy policies [64- 66,69]. For instance, Virginia state -owned app Covid wise and North Carolina Slow Covid app have virtually the same templated privacy policy. Although they disclose how data is collected, neither policy discloses concretely the reason why they are collecting specific data [66,71].

One commendable trend is how they collect data. Only necessary data is being collected for most apps. However, Healthy Together COVID-19 privately owned app, requests to "read contacts" with the intention of sharing information but certainly a loophole that gives permission to access one's contacts which the user may not want the app to have [58].

All apps report to share information with third party service providers either for research, to conduct quality testing or for optimization of their platforms. App developers prefer third party analytics software kits for the functionality aspect, saves them time and effort. [39]. However, this SDK have potential to collect personal information.

All apps disclose to collect geolocation data anonymously. However, North and South Dakota Care19 app, a digital diary shares this data with Foursquare a prominent location-data provider for marketers [67]. This data-sharing with commercial entity violates its own privacy policy [66]. In this scenario, Foursquare cannot be accountable to honor Care19's commitments regarding how it uses their personal data.

E. Challenges Facing digital contact tracing Applications

Manual contact tracing has proved that it has an impact in public health surveillance systems. However, they require a lot of resources both time and manpower. In addition, they depend on inherent human nature to recall crucial information [31]. Digital contact tracing on the hand is readily available and easy to adopt.

However, there are limited metrics that evaluate how this tools work. Digital contact tracing apps are, at best, a partial solution that should not be considered as the only approach to contact tracing. In addition, these apps do not stop the infection. They are only an alarm system, how the public responds to the alert determines their effectiveness during this pandemic. The government should get the incentives right, encourage better outcomes after the notification alert. There should be free testing, salary compensation schemes and integration with existing public health system [31,40].

Contact tracing apps face ethical issues due to sensitive information they collect; location and health status, which if not kept private and secure can lead to inadequate transparency or consent pitfalls [36]. There have been reports about personal health data collected for purposes of contact tracing leaked on the internet [49]. Software developers must inform via the privacy policy of the application, how personal data is being collected, processed, and if they share this data with third party applications [47]. All the google notification exposure apps report to share data for research and with other third-party entities. Similarly, despite Apple and Google having rigid third-party tracing restrictions, they offer access to their Application Programing Interface to any entity that wishes to implement their notification apps, without taking into consideration their privacy policies [62-64].

Some concerns are that apps may turn into an "immunity passport" and may be required for an

individual to show their health status before using public transportation or attending a sporting event [37]. Some are looking at how China, an authoritarian government, used this type of technology to impact the pandemic and flatten the curve [55]. With the recent vaccine this may be more of vaccination status especially for purposes of travel.

Population perception on contact tracing app matters. If people feel they cannot trust a certain app then adoption rate decreases yet mass local uptake determines their effectiveness. The market is also flooded with so many of these apps, yet the public has patience to only one perfect consensus tool [47]. Italy is one of the countries that suffered a great deal during the pandemic initial phase. Desperate to curb the spread of the coronavirus it released a highly contested app in June in four of its regions despite the privacy concerns of their citizens. The app is named "Immuni" [37].The app relies more on geo-location feature which was of great concern to the public. The perception was that the app stores the geo location data collected [46]. In a county of over 60 million people the app has just over 5 million downloads on google play store. Contact tracing apps depend solely on goodwill of the people and work best perfectly if a lot of people embrace and download them [37].

Technical performance issues have been reported on this apps. Australia's covidsafe was reported to have suboptimal compatibility with iPhone. False positive alerts can only be ignored so many times before people ignore them altogether.

Cybersecurity attacks have been reported by International Digital Accountability Council (IDAC) report, including the CDC'S app [39]. France experienced a cyber-attack on 22 March 2020 that disrupted their health systems in the middle of the pandemic [44]. The council also reported that Out of 108 applications from across the globe analyzed only 20% of those applications had an explicit mention of whether personal data is anonymized, or pseud anonymized. While a few applications used a Software Development Kit, the report said that it was unclear if the data from these was shared with a third party without consent [39].

Beyond the concern about effectiveness and security of these apps, new challenges of access and equity face m-health apps. The technology on which most apps rely on smartphones is not equitably distributed among vulnerable population and the elderly [31,46,55.]

User adoption obstacle is another challenge facing contact tracing applications. Whether to make them mandatory or voluntary is upon various countries policies. China is one country that has embraced county wide mandatory use, other countries like Turkey only require mandatory use for individuals who are already infected while India only requires one to download these apps [45]. There are global concerns that this will be apps eventually be used as surveillances tools impeding more on public privacy.

F. Conclusion

The pervasive nature of the coronavirus disease has transformed the lives of almost every individual and group globally. This paper is a survey on both traditional and modern contacting tracing especially with COVID 19, how HIPPA influences contact tracing and the challenges facing digital contact tracing.

We compared contact tracing applications with HIPPA privacy rule principles and enlisted key finding in terms of transparency and permission authorizations, disclosure use of data collected and sharing of information with third party entities. some of COVID-19 contact tracing apps we interacted with access permissions that can be misused [68]. Application permissions observed such as "read external storage" have the potential to be further exploited

and give access to information, such as image metadata and location. Although most apps are not bound by HIPPA they have put their own security programs in place that protects personal information on their end.

The integration of digital tools brings with the potential technical benefits though inherent trade- off between privacy and public health benefits still looms. The success of digital contact tracing to control coronavirus will depend on widespread public goodwill to download and adopt this technology with promise that personal health information is preserved.

Conflict of Interest: On behalf of all authors, the corresponding author states that there is no conflict of interest.

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