

Comparative Study of Contact Tracing Applications Development in Singapore and Indonesia (Case Study: TraceTogether and PeduliLindungi)

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Comparative Study of Contact Tracing Applications Development in Singapore and Indonesia

(Case Study: TraceTogether and PeduliLindungi)

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Kata Kunci

CTAs;
COVID-19;
Singapura;
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Abstrak

Salah satu upaya dalam penanganan pandemi COVID-19 adalah penelusuran (*tracing*) terkait kontak erat dari kasus positif. Hal ini untuk mengidentifikasi tempat dan waktu dari orang yang berkontak erat dengan pasien positif COVID-19 serta menginformasikan orang yang terindikasi positif COVID-19 guna mencegah penyebaran lebih lanjut. Oleh karena itu, masing-masing negara telah merilis *Contact Tracing Applications* (CTAs) sebagai pendukung proses *tracing*. Aplikasi TraceTogether dan PeduliLindungi merupakan contoh perwujudan dari *Contact Tracing Applications*. Penelitian ini bertujuan untuk membandingkan perkembangan CTAs di Singapura dan Indonesia dalam upaya penanganan pandemi COVID-19. Penelitian ini menggunakan metode penelitian studi pustaka untuk memmanifesasikan pengembangan CTAs di Singapura dan Indonesia. Dalam penelitian ini memfokuskan pada perbedaan pengembangan aplikasi yang telah diterapkan di kedua negara: Singapura sebagai pelopor CTAs dengan aplikasi TraceTogether dan Indonesia yang terinspirasi dari Singapura dengan merancang aplikasi PeduliLindungi. Hasil penelitian ini menemukan adanya perbedaan terkait pengembangan CTAs di Singapura dan Indonesia pada keamanan data pengguna, perbaikan fitur *check in*, peningkatan performa aplikasi, dan penyempurnaan tampilan fitur dalam aplikasi. Penelitian ini diharapkan bisa menjadi bahan pertimbangan dalam pengembangan CTAs yang lebih baik. Hal ini sebagai salah satu langkah pemulihan kedua negara pasca pandemi COVID-19 dalam pendekatan kesehatan melalui aplikasi tersebut.

Keywords

CTAs;
COVID-19;
Singapore;
Indonesia;

Abstract

One way to handle the COVID-19 pandemic is tracing related to close contacts of positive cases. This is to identify the place and time of people who have close contact with positive COVID-19 patients and inform those indicated as positive for COVID-19 to prevent further spread. Therefore, each country has released Contact Tracing Applications (CTAs) to support the tracing process. TraceTogether and PeduliLindungi applications are examples of embodiments of Contact Tracing Applications. This study aimed to compare the development of CTAs in Singapore and Indonesia to deal with the COVID-19 pandemic. This research used a literature research method to manifest the development of CTAs in Singapore and Indonesia. His study focused on the differences in application development that have been implemented in the two countries: Singapore as a pioneer of CTAs with the TraceTogether application and Indonesia which Singapore inspired by designing the PeduliLindungi application. This research is expected to be considered in the development of better CTAs. This is one of the recovery steps for the two countries after the COVID-19 pandemic in approaching health through the application.

Introduction

Based on a WHO report dated 14 to 20 February 2022, confirmed cases of COVID-19 represent more than 422 million cases and more than 5.8 million deaths globally (1). Corona virus disease (COVID-19) is an infectious disease caused by the SARS-CoV-2 virus. People infected with this virus will experience mild to moderate respiratory illness and recover without requiring special treatment. However, it will become seriously ill in some cases and require medical attention. Some people who have a more serious risk of getting this disease have comorbidities such as cardiovascular disease, diabetes, chronic respiratory disease, or cancer (2). In tackling the issue of controlling the COVID-19 pandemic, some countries have turned to *contact tracing* namto keep the economy going. Also, epidemiological modeling shows that if cases are identified effectively through strict testing protocols, comprehensive contact tracing by identifying all possible exposed people, and people who are positive for COVID-19 are promptly quarantined. This strategy can control the spread of the virus optimally (3).

In disaster management there are two approaches, namely *soft power*, and *hard power*, these two things are called disaster mitigation. Both of these approaches require disaster communication. However, communication in a disaster is not only needed in a disaster emergency but also during and pre-disaster. There are several efforts to prepare communities in disaster-prone areas, understanding adequate information about potential disasters, training, and internalizing habits in dealing with disaster situations (4). But abundant information alone is not enough to make people aware of the dangers of a threatening disaster. Community preparedness efforts against disasters are considered not optimal, therefore special efforts are needed to increase knowledge about disaster mitigation (5). Information delivery also needs to be done appropriately. Errors in communicating information can make a situation worse. Seeing this condition, the communication approach can use a digital communication medium used by the wider community, one of which is through *Contact Tracing Applications*.

Based on Jilian et al (2015) research, contact tracing is the main key in controlling the Ebola epidemic that has occurred in (6). This involves identifying all people exposed to an infected person (also known as contact identification) and monitoring for an incubation period of about 21 days. With efficient *contact tracing*, the period during which an infected person can transmit the disease can be minimized (6). *Contact tracing* is the process of identifying people in close contact with an infected person so that the exposed target can be informed for self-isolation and quarantine, thereby breaking the chain of transmission. Contact tracing is transforming into an application from the increasingly rapid transmission of COVID-19. *Contact Tracing Applications* are an important tool for the government and the public in preventing the spread of new pandemic diseases, such as COVID-19 (7). The current COVID-19 pandemic motivates technology developers to develop smartphone applications for effective and easy-to-use disease tracking. Many *Contact Tracing Applications* (CTAs) are based on Global Position System (GPS), Bluetooth, and WiFi technology in performing tracking functions (8). The use of CTAs during the COVID-19 pandemic has been implemented in several countries such as India which developed Aarogya Setu, the Russian Federation with Facial Recognition, Iran, Israel, Poland, South Korea, and Singapore which developed TraceTogether (9).

The Singapore government uses *artificial intelligence* and *big data* to support CTAs. Singapore is superior in handling the COVID-19 pandemic because it has succeeded in combining elements of engineering and scientific approaches (10). The government is also developing "TraceTogether" CTAs using Bluetooth technology to help reduce the spread of the virus by tracing contacts related to positive cases of COVID-19 in Singapore. The official TraceTogether application was released on March 20, 2020, which was developed by a company affiliated with the Singapore government, namely GovTech (Government Technology Agency).

TraceTogether has undergone development and improvements starting from version 1.5 to the latest version 2.11. However, there are several issues in the development of the TraceTogether application, including issues related to privacy and security of user data where there are still gaps. In addition, the use of these CTAs can cause smartphone battery power to tend to run out faster, especially for iOS device users. Problems also occur in the user's vaccine status which has not been updated in the application, and the data is not in sync with the reality on the ground. This is similar to what has happened to people who have recovered from COVID-19 and are self-quarantining at home. The status that should be "cleared" still says "not cleared" in the app. As a note the status of "not cleared" prohibits someone from accessing public facilities.

The Indonesian government has also made the same effort in tackling the spread of COVID-19 through the "PeduliLindungi" CTAs. PeduliLindungi is an application developed to stop coronavirus disease. This application relies on the active participation of the community to share location data of each other when carrying out activities in public facilities so that tracing contact history with COVID-19 sufferers can be carried out. PeduliLindungi was officially released in April 2020 and developed by PT Telekomunikasi Indonesia Tbk, and the copyright is exclusively licensed to the Government of Indonesia,

in this case, the Ministry of Communication and Information and the Ministry of State-Owned Enterprises (BUMN) (11).

PeduliLindungi in its implementation is still undergoing improvements and developments starting from version 2.3.0. up to the latest version 4.0.2. However, over time, several problems emerged, namely in the system aspect, including guaranteeing the security of user data that has been vaccinated against COVID-19, guaranteeing security from hacking, and easy and fast application accessibility. In addition, in the government aspect, it includes guarantees from related institutions regarding the management of the PeduliLindungi application, coordination and accountability between government agencies in the management of the PeduliLindungi application. Community Aspects, including guaranteeing the accuracy of data for people who have been vaccinated against COVID-19 and guaranteeing alternative access for people who do not have electronic devices (12).

Based on the above considerations, a comparative study between Tracetgether and PeduliLindungi CTAs needs to be carried out to show the differences between TraceTogether and PeduliLindungi in the development of each version of the two CTAs. It also shows the advantages and disadvantages of the two CTAs are in the COVID-19 tracing process. The main objective of this study is to compare the development of CTAs in efforts to deal with the COVID-19 pandemic in Singapore and Indonesia. While the benefit of this research is that we can find out the differences in the development of *Contact Tracing Applications* on TraceTogether and PeduliLindungi.

Methods

The research method used in this study is a descriptive qualitative method. Research with qualitative methods is a research method that intends to understand the phenomena experienced by research subjects such as behavior, perceptions, motivations, actions and others holistically, and by descriptive in the form of words and language in a special context that naturally and by utilizing various natural methods (13). The nature of this research is descriptive analysis, namely the analysis conducted about the phenomena that occur in the present. The process is in the form of collecting or compiling data and interpreting the data descriptively. Descriptive analysis can provide a reflective or comparative picture by comparing similarities and differences in some instances or phenomena (14). There are several steps taken in analyzing qualitative descriptive data: collecting data and information needed regarding the two CTAs, identifying existing problems and analyzing in depth, and providing recommendations for developing the two CTAs.

The primary data in this study are the user manual for the TraceTogether and PeduliLindungi applications (15)(16). Furthermore, also use the statement by the Ministry of Health of Singapore Mr. Gan Kim Yong in Parliament regarding the Government's Renewal of the Government's Response to COVID-19, the Decree of the Minister of Communication and Information of the Republic of Indonesia Number 171 of 2020 concerning the Determination of the PeduliLindungi Application in the Context Implementation of Health Surveillance for Handling Corona Virus Disease 2019 (COVID-19). The secondary data in this study was obtained from article searches, with details of 3 articles from PubMed, 4 articles from Google Scholar, and 3 articles from other journals.

Results

From the study of the development of Contact Tracing Applications implemented in Singapore (TraceTogether) and Indonesia (PeduliLindungi) in dealing with COVID-19, the authors found differences in the indicators of the legal basis, privacy and security of user data, developers of CTAs, active participation of CTAs stakeholders presented in Table 1.

Table 1 Differences in the Development of Contact Tracing Applications TraceTogether and PeduliLindungi in Handling COVID-19

Contact Tracing App Development Indicator	TraceTogether	PeduliLindungi
The Legal Basis	COVID-19 (Temporary Measures) Act 2020 Sixth Schedule About Digital Contact Tracing System (17).	1 Decree of the Minister of Communication and Information of the Republic of Indonesia No. 171 of 2020 concerning the Determination of the Care to Protect Application in the Framework of Implementing Health Surveillance for Handling the Corona Virus Disease 2019 (COVID-19) (11).
2 Privacy and security of user data Contact Tracing App	<ul style="list-style-type: none"> a. TraceTogether stores user data namely user mobile number, user identification details (email), and user anonymous ID b. Saved data only lasts for more than 25 days c. TraceTogether cannot access images, videos, files, locations, wifi, and cellular networks stored on the user's device, because they are based on Bluetooth. Except, when users provide criticism and suggestions in the problem report feature and use the Safe Entry check-in feature. d. In the check-in process, it can be through the TraceTogether application or by the token checking pod. Regarding token checking, the pod is a Bluetooth-based device and has a battery life of 4 to 6 months. e. Data can only be accessed after manually uploaded to the MOH server and data is only accessed for contact tracing purposes (18). 	<ul style="list-style-type: none"> a. PeduliLindungi stores data such as full name, No. Cellphone, email, and NIK. b. PeduliLindungi stores user data after the user has gone through the verification process and is encrypted while the service is operating. c. Cares Protect, can access camera, gallery, location, and user document access. d. Personal data is stored by PeduliLindungi using legal software from the Government of the Republic of Indonesia. e. PeduliLindungi has the right to store and use the user's Personal Data following the applicable laws and regulations for a minimum of 5 (five) years if it is no longer operating (16).
Developer Contact Tracing App	Government Technology Agency	PT. Telekomunikasi Indonesia Tbk
Active participation	Ministry of Health (MOH) dan SG United	Communication and Information Technology, Ministry of Health, National Disaster Management Agency, Ministry of State-Owned Enterprises, Ministry of Home Affairs, Ministry of Law and Human Rights, Ministry of Finance, Indonesian National Armed Forces, State Police Republic of Indonesia Presidential Staff Office, and other Ministries/Institutions to be determined later.

Source: Analysis Result Data From TraceTogether and PeduliLindungi Websites

TraceTogether and PeduliLindungi have undergone development in each version. The purpose of this development is an effort to overcome the problems that occur in CTAs. Based on this, the aspects of updating the two CTAs can be explained as follows:

Table 2 Differences in the Development of Each Version *Contact Tracing Apps*

No	Trace Together Version	Aspect Update	Peduli Lindungi Version	Aspect Update	Analysis
1.	1.5	New looks of MOH (Ministry of Health) upload page design	2.3.0	PeduliLindungi by utilizing Bluetooth technology to record the required information. This allows data exchange between gadgets within a Bluetooth radius that is also registered with PeduliLindungi. PeduliLindungi then identifies people who have been in close contact with people who have tested positive for COVID-19 or PDP (Patients Under Supervision) and ODP (People Under Supervision).	In the first version, TraceTogether focuses more on improving the appearance of the main page. Meanwhile, PeduliLindungi focuses on using Bluetooth for its use.
2.	1.6	a. Improve the security of "Bluetooth handshake" b. ID collection only needs once a day connected to the internet.	3.1.3	a. Indonesia COVID-19 Vaccine Registration b. Some improvements c. Improved performance	In the next version TraceTogether tries to improve data security. Meanwhile, PeduliLindungi made improvements such as the registration of the COVID-19 vaccine.
3.	1.9 (IOS) dan 1.8.1 (Android)	Already support for non-Singaporean mobile numbers for foreigners in Singapore	3.2.6	Bug fixes	In the next version TraceTogether makes it easy for foreigners to use the TraceTogether application. While PeduliLindungi focuses on improving features in the application.
4.	2.0	a. Requires ID verification to register for TraceTogether b. Receive personal medical information related to COVID-19 c. Already supports more Languages.	3.3.4	Bug fixes	TraceTogether in this version further improves data security and various other supporting features. While PeduliLindungi further improves application performance.
5.	2.1	a. There is an NRIC/FIN barcode feature to facilitate fast and secure check-in/out at all SafeEntry locations. b. It supports more languages, such as Bengali, Burmese, Chinese, English, Hindi, Malay, Tamil, and Thai.	3.3.5	Bug fixes	TraceTogether in this version provides easy access to support the tracing and tracking process, while PeduliLindungi is still working on improving application performance.

No	Trace Together Version	Aspect Update	Peduli Lindungi Version	Aspect Update	Analysis
6.	2.2	<ul style="list-style-type: none"> a. Can see Bluetooth exchange process and SafeEntry Quick Response (QR) history. b. Work pass holders who have not received a physical pass can register using the Date of Application. c. iOS users can tap and hold on the app icon for a shortcut to SafeEntry check-in. 	3.3.6	Bug fixes	TraceTogether provides ease of use regarding registration and integration with SafeEntry, while PeduliLindungi continues to improve features in the application.
7.	2.3	<ul style="list-style-type: none"> a. You can view TraceTogether and SafeEntry QR history, to check whether you have been to the places you visited that were affected by COVID-19 cases. b. Can add locations to the SafeEntry favorites menu, to easily check in to the locations you visit most often. 	3.4.0	Bug fixes	TraceTogether in this version adds information regarding locations affected by COVID-19 and makes it easier for users to check-in at favorite locations, while PeduliLindungi is still improving the performance of several features in the application.
8.	2.4	<ul style="list-style-type: none"> a. For Android & iOS users: added group check-in feature for SafeEntry b. For Android & iOS users: SafeEntry automatic checkout time extended to 24 hours. It helps shift workers in working all night. c. Siri iOS14 users can now set up Siri shortcuts. 	3.4.1	<ul style="list-style-type: none"> a. Revamp login b. Revamp register c. Revamp account & change account d. Some improvements 	TraceTogether in this version focus more on improvements to the Check-in feature, while PeduliLindungi focuses on overhauling account registers and logging in.
9.	2.5	<ul style="list-style-type: none"> a. It is available in the Huawei App Gallery. b. Check out SafeEntry through history within 24 hours. c. There is a Submit Error Logs feature. This feature serves to assist developers in understanding & further investigating problems that occur in the application. 	3.4.2	<ul style="list-style-type: none"> a. On-boarding page updates. Check-in & Check-out ticket page update. b. Update login & register page. c. Instructions allow location access permission requests d. Some improvements 	TraceTogether in this version can be used by users of Huawei smartphone devices and the addition of several other supporting features, while PeduliLindungi focuses on the page update system and location access permission updates as well as several other improvements.
10.	2.6	The application can be used by tourists visiting Singapore to use the SafeEntry check-in/out feature.	3.4.3	<ul style="list-style-type: none"> a. On-boarding page update b. Check-in & Check-out ticket page update. c. Login & register page updated. Instructions allow location access permission requests d. Some improvements. 	TraceTogether in this version provides easy use of the check-in feature for travelers, while PeduliLindungi still focuses on the page update system and location access permission updates as well as several other improvements.

No	Trace Together Version	Aspect Update	Peduli Lindungi Version	Aspect Update	Analysis
11.	2.7	<ul style="list-style-type: none"> a. The presence of a COVID Health Status Card - This card displays the user's vaccination status. b. Redesigned home screen. c. SafeEntry QR detection is now faster, especially when the QR code is blurry or farther away. d. Check-in group - When selecting family members for group check-in, users can tap the entire row, not just the checkbox on the right. 	3.4.4	<ul style="list-style-type: none"> a. Added User status feature. b. Color category update upon check-in. c. Check-out display updated. Update check-in status on travel diary. d. Location refresh during check-in. 	TraceTogether in this version focuses on improving the appearance of individual and independent check-in features and adding user vaccine status information, while in PeduliProtects updates and additions to the check-in, check-out display system, and location updates at check-in.
12.	2.8	<ul style="list-style-type: none"> a. Reorder SafeEntry favorites menu. b. Improvements have been made to the app to better detect valid SafeEntry QR codes when scanning. c. For Android users: users can now create SafeEntry widgets. d. For iOS users: the widget has been redesigned for easier access to the user's favorite places or group check-in. e. iOS users now have the option to change the profile name. 	3.4.5	<ul style="list-style-type: none"> a. Added User status feature. b. Color category update upon check-in. c. Check-out display updated. Update check-in status on travel diary. d. Location refresh at check-in. e. The TraceTogether fixes bugs . 	TraceTogether in this version makes improvements to the appearance and improvements to the SafeEntry QR code, especially for Ios and Android users, while PeduliProtect updates and additions are still fixed on the check-in, check-out, and location update display systems during check-in and fixes on bugs.
13.	2.9	<ul style="list-style-type: none"> a. Removed the user's possible exposures menu. In the future, MOH/MOH will send SMS and/or call to notify users if they have the possibility of being exposed to COVID-19. b. There is a menu of PCR or ART test results registered in the last 24 hours. Users can view test results on the home screen in the COVID Health Status section. c. Added refresh button for "Your COVID Health Status" d. There is a button feature that is useful for checking out from the previous place e. There is a fix regarding Bluetooth devices. 	3.4.6	Several improvements to the app.	TraceTogether in this version focus more on improving some features and adding information related to PCR or ART test results, while PeduliLindungi focuses on improving the application.
14.	2.10	<ul style="list-style-type: none"> a. Can see the user's COVID-19 vaccination and test status, when the device is weak/has no internet connection b. There is a place reminder feature that you forgot to visit try our widget c. Bug fixes and various improvements 	4.0.2	<ul style="list-style-type: none"> a. e-HAC web view for international travel b. Simplify the registration and onboarding process c. Separating the flow between Foreign Citizens & Indonesian Citizens d. Making some features available in Chinese & Japanese. 	TraceTogether in this version focuses more on fixing and improving some features, while PeduliLindungi includes the addition of e-HAC and foreign-language features. Apart from that, there are some feature enhancements.

Source: Analysis Result Data From TraceTogether and PeduliLindungi Websites

Discussion

Contact tracing applications in Singapore and Indonesia are regulated by law. Policies related to TraceTogether's operations are issued by the Ministry of Law Singapore, while PeduliLindungi is issued by the Ministry of Communication and Information. When compared to the contents of the legal basis that governs the operation of CTAs, PeduliLindungi is more detailed and clear than TraceTogether's general legal basis.

Generally, the problems that occur in CTAs are the privacy and security of user data. TraceTogether and PeduliLindungi have several features to support user security and privacy. This feature has a function to store data in the form of mobile phone numbers and user emails. In addition, the data can only be accessed by the government. Then, the two CTAs have differences in accessing user applications, which include the camera, gallery, location, and user documents. Data storage on TraceTogether has a maximum time limit of 25 days after which it is automatically deleted from the user's device, while PeduliLindungi stores data for up to PeduliLindungi for 5 years if it is no longer in operation. TraceTogether has an alternative option in the check-in feature, namely using a token checking pod.

This app is developed and created by a government-owned company. TraceTogether is developed by GovTech. GovTech is a Singaporean government-owned company that focuses on developing and manufacturing application-based digital technologies aimed at citizens, businesses, and government agencies. Meanwhile, PeduliLindungi was developed by PT. Telkom Indonesia Tbk is a State-Owned Enterprise (BUMN). This company focuses on Information and Communication Technology (ICT) services for telecommunications networks in Indonesia. In the institutional aspect, both CTAs are supervised and supported by government agencies that function in their use in the wider community. TraceTogether is overseen by the Ministry of Health (MOH) and supported by SG United. Meanwhile, PeduliLindungi is used for the benefit of many Ministries/Institutions. PeduliLindungi is more complex in the active participation of stakeholders.

Based on the analysis results, it can be concluded that *Contact Tracing Applications*, TraceTogether have advantages in terms of privacy and data security because they are based on Bluetooth (see table 1). This causes the application not to need to access the user's camera, gallery, location, and documents, and user data is only stored in a short time. In addition, TraceTogether is a *contact tracing application* that uses Bluetooth with a wireless network standard to communicate between devices over short distances, usually less than ten meters using UHF radio waves. The use of Bluetooth in TraceTogether is when two phones stay close together for a long time to exchange temporary ID numbers between apps on both phones (19). Meanwhile, PeduliLindungi has advantages in stakeholders who play a role and a more detailed legal basis than TraceTogether. Stakeholders who play an active role in the development of PeduliLindungi are more complex, consisting of several relevant ministries.

CTAs TraceTogether and PeduliLindungi in operation have undergone updates and improvements. This aims to improve application performance and strengthen the security of user data. Based on the analysis of the development of each version of *contact tracing* applications (see table 2), TraceTogether prioritizes improvements related to user data security and improvements to the check-in feature. In contrast PeduliLindungi focuses more on improving application performance and improving the appearance of the features available in the application.

Singapore is a pioneer country in developing CTAs in the face of the COVID-19 pandemic in the form of TraceTogether. The function of TraceTogether is to collect information about the movement of people, especially when they visit or spend significant time in public places (20). In addition, it can provide information regarding individuals who are exposed to or infected with COVID-19 to get more appropriate and efficient treatment. TraceTogether also functions as an effort to reduce transmission, especially to vulnerable groups such as the elderly group. Then, TraceTogether has a function as a consideration for the government in issuing quarantine orders (21).

In contrast to Indonesia, which developed CTAs in the form of PeduliLindungi to overcome COVID-19. The functions of PeduliLindungi for the government side include ensuring the implementation of social distancing, compliance with health protocols in public places, tracking (tracing) people infected with COVID-19, tracking community distribution patterns through GPS and Bluetooth features, data entry for the preparation of policies that will be implemented next, as well as a medium for consultation and health services through the Teledokter feature (12).

Then, in terms of public facilities, the function of Care to Protect is to ensure that people in public facilities are healthy and free from COVID-19. Furthermore, if viewed from the community's perspective, the function of Care Protect is to inform about the zoning of the spread of COVID-19 and ensure that public facilities are safe from the spread of COVID-19.

Based on the results of the study, the implication that the author can propose is that both CTAs must improve and ensure the security of users' data because the increasing data security will increase user trusts in using the CTAs application. Thus, it can maximize the use and function of CTAs. Regarding the ease of use of CTAs, developers must accommodate all of society levels. This can be a consideration,

especially for PeduliLindungi developers to reach people who don't have gadgets. By using a token checking pod or the like as has been applied to TraceTogether can be the great choice.

Conclusions

Since WHO declared COVID-19 as a global pandemic, all countries in the world have implemented various efforts and policies to overcome the pandemic. One of the efforts is to conduct contact tracing (tracing) through contact tracing applications. Based on the study above, there are several differences in the development of the two CTAs (TraceTogether and PeduliLindungi) in supporting the tracing process to deal with the COVID-19 pandemic. The comparison results of development on the two CTAs show that there are advantages and disadvantages including user data security and privacy, improved check-in features, increased application performance, and improved appearance of features in applications.

Based on the conclusions above, the suggestions given based on the research results are as follows: TraceTogether should maximize the active participation of stakeholders in the government and private sector. In addition, it is necessary to increase the update status between the user's health condition and those in the application.

As for PeduliLindungi, it is better to provide options related to the check-in process, namely via Bluetooth. In accommodating the use of PeduliLindungi to the maximum and can be used as a whole by users, it is necessary to have alternative tools such as token checking pods on TraceTogether. In addition, related to data security and privacy, the storage period should be shortened to prevent user data leakage.

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