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Pandemics, privacy, and adoption of technology: Perceptions of the use of digital tools and data sharing during COVID-19 from 10 Latin American countries

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Abstract

This study describes the perception, adoption, and acceptance factors involved in the deployment of digital technologies for public health in Latin America and considers the implications for future digital health interventions. We conducted a descriptive analysis using nationally representative data from a phone survey conducted in 2020 in 10 countries in Latin America. We found that early in the pandemic, in countries with existing applications, 74% of the population used a smartphone, 47% had knowledge of the government app to report symptoms, but only 2% reported using it. Those interviewed reported that they are willing to share their personal data during a pandemic (61%) – 50 percentage points higher than in non-pandemic times, although understanding how their personal data was used by the government and private companies was extremely low. More than 70% reported that they would use an application to report symptoms and would use an app that accesses their location or that uses contact tracing technology to alert them about possible exposure. Also, at least half of the users agree with preventive measures against COVID-19 such as daily follow-up calls, tracking via GPS for quarantine enforcement, and daily visits. In all countries, adoption of digital technologies increases if individuals or their relatives report they are infected; it decreases when end-users do not trust the anonymity policies or are concerned about government surveillance. Yet, encouraging greater adoption of digital technologies strongly depends on who designed the technology. Results show that 73% of users would prefer an app designed by an international organization such as the WHO to an app designed by the local government (64%) or a telephone company (56%). The study concludes with a reflection on the promising results of digital technologies and discusses the importance of considering users' perceptions, factors for acceptance, and trust when pursuing adoption of digital technologies.

Keywords: public health, digital health, pandemic, health, digital transformation, trust, technology adoption

JEL codes: O33, I10

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Introduction

Coronavirus cases spread rapidly in Latin America and the Caribbean (LAC); it took only 37 days after the first confirmed case in Brazil for all countries in the region to have reported at least one case (Savedoff et al., 2020). In response, by mid-March 2020, most countries adopted restrictive measures such as banning international flights, prohibiting mass public gatherings, suspending in-person education, and closing nightlife. On 22 May 2020, the World Health Organization (WHO) declared South America the new epicenter of the pandemic (Feuer, 2020).

Traditional and innovative digital technologies have played a key role in national strategies to fight COVID-19. Most countries have launched official websites that facilitate fast and effective communication and information sharing. Brazil and Panama have implemented a chatbot and WhatsApp channel to monitor people's symptoms and if needed refer them to the nearest healthcare provider (Goberno do Estado do Ceara, 2020; Cardoso, 2020; Ministerio de Salud de Panamá, 2020). Other countries such as Colombia strengthened their telemedicine services for internal medicine, nutrition, and dermatology, etc., to provide continuity of care during the crisis. Countries such as Chile (CoronApp), Mexico (COVID-19MX), Costa Rica (EDUS), and Argentina (CUIDAR) launched an application that allows users to perform a self-evaluation of their symptoms, receive notifications from the health authorities, and for suspected or confirmed cases, data can be monitored in real-time to ensure compliance with quarantines. Most countries are presently deploying applications to support COVID-19 vaccination efforts and to provide digital credentials to their population for vaccines and laboratory results.

Although deployment of digital technologies to contain the virus has increased, few efforts have been made in Latin America to explore citizen perception, knowledge, and acceptance of these technologies and data-sharing during pandemics. Acceptability of digital interventions has been an issue in past and current pandemics, as many applications focus more on collecting personal information and less on giving patients information or benefits in return (Anglemyer et al., 2020; Servick, 2020). Prior studies have proposed frameworks for technology acceptance and adoption (Taherdoost, 2017), and others have demonstrated that in addition to the perceived social impact and benefits to the end-user (Garavand et al., 2016; Trang et al., 2020), adoption of digital technologies is affected by user perception and trust with respect to surveillance, privacy, and use of data (Golinelli et al., 2020; Altmann et al., 2020). New technologies may experience additional barriers, as users may not adopt them without evidence of effectiveness (Budd et al., 2020). Empirical studies among African students in China and community health centers in Thailand show that the perceived ease of use and usefulness are important and effective factors in the adoption of health technologies (Khan et al., 2019; Kijsanayotin et al. 2009). Another study using data from diabetic patients in the United States, Canada, and Bangladesh shows that peers' perception of the importance of using health technologies (social influence), and the perceived enjoyment derived from this use (hedonic motivation) are also key factors in the adoption of these technologies (Dwivedi et al., 2017).

Making a technology available is not sufficient to guaranteeing its adoption. First it is necessary to understand users' perceptions of these technologies in order to increase usage and effectiveness during pandemics or health emergencies in general and in Latin America. In a context of low trust in public institutions, low interpersonal trust, high levels concern about privacy, and lack of data protection frameworks, it is important to understand the citizens' perceptions regarding the adoption of digital tools during a pandemic (Servick, 2020). To this end, using results from a phone survey in 10 countries in Latin America, this study aims to conduct a descriptive analysis of the perceptions and reported behaviors regarding the acceptance of digital technologies, including current levels of knowledge, likelihood of adoption of current or future government-supported digital interventions, and perceptions on sharing data during the pandemic, in particular the response to specific digital innovations (such as AEN and technology for monitoring and enforcing quarantines). We analyze these findings to offer considerations for policymakers with respect to introducing digital services for the current pandemic and future health emergencies.

Contextual framework: Technology adoption during the COVID-19 pandemic

During the pandemic, many countries tested strategies to increase adoption, ranging from mandatory requirements to monetary benefits. The TraceTogether mobile app in Singapore, for instance, reached only 30% of national uptake by

June 2020 – six months after its launch (Budd et al., 2020). However, its widespread usage increased with the adoption of TraceTogether tokens, a physical Bluetooth-enabled device that exchanges signals with other tokens or TraceTogether mobile apps nearby, and the app's mandatory usage to access services or activities such as cinemas, restaurants, shopping malls, etc., (Singapore Government, 2020). A UK-based focus group study about how to incentivize the acceptance of contact-tracing apps also shows that through traditional channels, social networks, and text messages, uptake can be improved by communicating the use and privacy terms and the contribution to the "common good" (Williams et al., 2020). In addition, users who have previously experienced an epidemic and perceive it as a higher threat may also be more likely to adopt a technology to enforce quarantine; in a 2006 study after the SARS epidemic, more than half of citizens in Hong Kong, Singapore, and Taiwan favored using electronic bracelets to monitor quarantined people, compared to only 40 percent in the United States (Blendon et al, 2020).

Some Latin American countries have tested digital innovations to expand their public health interventions, such as mobile Automated Exposure Notification (AEN) solutions as part of their contact-tracing strategy or wristbands as part of their quarantine monitoring. Ecuador and Peru, for example, launched the application ASI and *Peru en tus manos*, a tool that alerts citizens within a certain distance of a suspected or confirmed case of COVID-19 (Heredia, 2020; Gobierno de Perú, 2020). Similarly, Uruguay launched a Bluetooth-based application (Coronavirus UY) that exchanges encrypted codes between smartphones within five meters for at least five minutes and sends notifications if there is a risk of infection (El Observador, 2020; Gonzalez, 2020). Individuals who have been within five meters of a suspected or confirmed case for 15 minutes will receive a message "You should get tested" (Subrayado, 2020). Colombia also launched an app (CoronApp) that, when enabled by users, provides access to their location (GPS) and Bluetooth to detect possible infected people. In Barbados, tracking bracelets connected to an app (BIMSafe) are issued to international travelers to monitor that they stay within government-approved locations; an alarm goes off and authorities get notified if individuals breach quarantines (Phillips, 2021; Henry, 2021). Other countries in the region have also begun providing COVID-19 digital immunization certificates. Chile introduced the mobility pass, a digital QR code certifies if the person completed their vaccination schedule, and Uruguay created a digital certificate available 48 hours after receiving the second dose of the vaccine.

Proliferation of these tools has opened a global debate on the value and ethics of current technologies and future innovations, including discussions around the privacy and security of data collected by these systems, most recently AEN and digital COVID-19 vaccination certificates. The WHO issued 17 principles on the ethical deployment of digital proximity-tracking technologies, noting that the download and use of such applications should be voluntary without additional incentives from the government or private parties (WHO, 2020). The General Data Protection Regulation (GDPR) and other privacy frameworks also state that voluntary assent is required, and information collected by the application should be considered personally identifiable information and be protected from access by mobile communication networks (Bradford et al., 2020; GDPR, 2016; CDC, 2019). To date, most designers have prioritized voluntary use; however, non-consensual tracking has been used in China, Israel, and India (Shwartz and Aridor, 2020; Halbfinger et al., 2020; Srivastava and Nagaraj, 2020). Uruguay, on the other hand, explicitly requests that users provide their consent when they are configuring the national coronavirus application, Coronavirus UY. Global efforts have also begun to create guidelines for COVID-19 credentials, such as the WHO working group to support the design of Digital Documentation of COVID-19 Credentials (DDCC), the Good Health Pass Collaborative, and the COVID-19 Credentials Initiative. Israel, for instance, has implemented the "green pass," a smartphone application permitting vaccinated individuals access to public venues such as gyms, hotels, and entertainment; and the European Union officially launched the "EU's Digital COVID Certificate" on 1 July 2021 to facilitate the re-opening of economic and social activities (Gostin et al., 2021). Latin American countries are working to adopt the DDCC standards through the LACPASS project, supported by *Red Americana de Cooperación de Salud Electrónica* (RACSEL), the Pan American Health Association, and the Inter-American Development Bank.

Methods

We obtained nationally representative data from a phone survey conducted by the Inter-American Development Bank (IDB) in 10 Latin American countries: Chile, Costa Rica, Ecuador, El Salvador, Honduras, Mexico, Panama, Paraguay, Peru, and Uruguay. The data-collection methodology followed that used by Altman and colleagues' cross-country non-experimental online survey study conducted in France, Germany, Italy, the UK, and the US to investigate

the acceptability of contact-tracing applications in those countries (Anglemyer et al., 2020), with the difference that half of the respondents in our study randomly responded to questions about an app with an opt-in regime (downloaded voluntarily) and the other half about an opt-out regime (installed automatically). In addition, the survey collected data on trust and protection of data-privacy rights in the context of the pandemic, trust and technology, and perceptions and behaviors toward government policies (i.e., restrictions and new technologies) during the pandemic. The data was collected by three different firms. One firm collected data in Chile, Paraguay, Peru, and Uruguay between 29 July and 22 August 2020. A second firm collected data in Mexico between 31 August and 8 September 2020. A third firm collected data in the rest of the countries between 4 August and 26 September 2020 (see Table 1 below).

Table 1. Time period of data collection by country in 2020

Country	Data collection		COVID-19 cases *		COVID-19 deaths*		Date of government app launch **
	Started	Ended	Started	Ended	Started	Ended	
Chile	29 July	20 August	1,869	2,069	49.6	56.1	16 April
Uruguay	29 July	22 August	35	44	1.0	1.2	20 March
Paraguay	30 July	18 August	69	144	0.7	2.1	31 March
Peru	30 July	15 August	1,233	1,649	57.9	80.8	7 Mayo
Ecuador	4 August	28 August	550	690	33.2	37.2	14 August
El Salvador	6 August	23 August	289	381	7.9	10.3	-
Honduras	7 August	5 September	470	665	14.8	20.8	-
Costa Rica	8 August	26 September	461	1,427	4.7	16.4	28 March
Panama	9 August	27 September	1,754	2,604	38.6	55.1	19 February
Mexico	31 August	8 September	467	500	50.3	53.1	6 April

Note: Calculations are based on European Centre for Disease Prevention and Control (CDC) data.

* Cases and deaths per 100,000 inhabitants. COVID-19 cases and deaths are calculated from Monday to Friday and dates may differ slightly from the data collection dates. For each country, data was reported in the following data range: Uruguay between 29 July and 24 August; El Salvador between 6 August and 23 August; Honduras between 7 August and 8 September; and Costa Rica and Panama between 10 August and 28 September.

** Government app launch refers to the release date reported in iOS or Google Play. The app's release date of the app may differ from the launch date by the government. For Chile, Paraguay and Perú, we used the launch date announced by the government.

In each country, around 1,000 individuals were surveyed in a nationally representative phone survey; they were all at least 18 years old and selected randomly from a telephone-number database. The survey included questions about the individuals' usage and perception of technology, specifically the application in the context of COVID-19, as well as basic sociodemographic indicators. Description of the complete survey instrument can be found in Appendix 1. All analyses were done using Stata (version 15).

Results

A summary of the sample characteristics across countries is provided in Annex 3 Table 1. On average, individuals were 42 years old and a little over half were women (51%). Approximately 49% of the respondents had not graduated from high school. Education levels varied across countries; while close to 50% of individuals in Ecuador and Peru completed high school, no more than 35% did in Honduras and El Salvador. The majority of respondents lived in a household with four members. Around 47% of the households included children under 12 years old, and almost 40% had someone 60 years or older.

Overall, the levels of general knowledge and usage of digital tools in Latin America were high. Nearly 74% of respondents reported they had used a smartphone in the week prior to the survey interview, although the results varied by country. In El Salvador, Ecuador, Panama, and Uruguay, more than 80% of the respondents used a smartphone the week prior to the interview. In Chile, Peru, and Paraguay, this figure was lower (approximately 60%). And in all countries, close to 90% of the individuals reported using social media and instant messaging. However, only 35% used their smartphones for online payments and shopping; the percentage of users in Chile who reported using their smartphones for online shopping was the highest in the region, some four times (or 50 percentage points) higher than in El Salvador.

Knowledge of digital tools for COVID-19 was moderate; 47% of individuals knew about the existence of smartphone applications or websites that allow them to report their symptoms without visiting a health worker. However, adoption was extremely low, as only 2% acknowledged using a government app on their smartphones, although many countries were launching applications at the time of the survey (see Tables 1 and 2). Patterns in adopting government apps also varied across countries. Individuals in Chile, Uruguay, Panama, and Costa Rica had similar adoption rates (4–5%); however, those in Chile were less informed about the new applications (19%). These numbers suggest that additional factors besides the knowledge of a tool's existence play a role in its adoption. Given that this data was collected early in the pandemic, all adoption rates were low (5% or less).

Understanding how personal data was used by the government and private companies, on the other hand, was extremely low. In the region, 73% of individuals assure having control over their personal data. However, half of the individuals reported knowing that the government can legally use their personal data in emergencies (52%), and less than 40% reported knowing how government (26%) and private companies use their personal data (37%). El Salvador had the largest share of individuals who reported knowledge that the government can legally access their data in emergencies (66%). Peru, Paraguay, and Uruguay were the countries with the lowest incidence of individuals with knowledge of how their personal data is used (see Table 2).

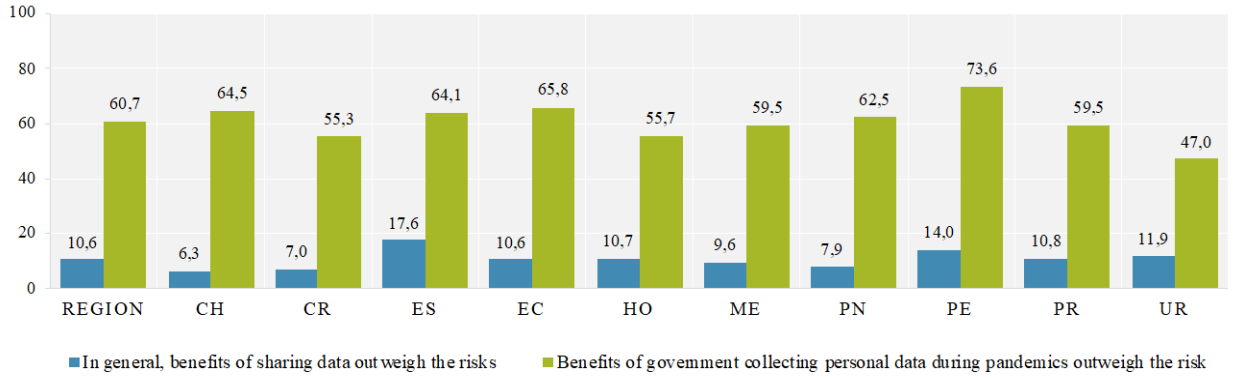
Table 2. Current levels of knowledge and adoption of technologies (%)

	Region	CH	CR	ES	EC	HO	ME	PN	PE	PR	UR
Technology adoption: smartphone usage											
General	74	63	77	83	90	73	71	80	58	62	80
Social medias apps	90	93	91	91	95	85	88	93	97	89	85
Instant messaging	97	98	97	96	98	94	96	98	99	99	99
Online payments	35	68	40	18	18	20	41	46	40	27	41
Knowledge and adoption of government apps											
Knowledge of app to report symptoms	47	19	49	47	43	52	63	59	40	26	69
Currently install government app	2.0	4.0	4.0	0.1	0.4	0.4	0.5	4.0	0.1	1.0	5.0
Perception and knowledge about sharing personal data											
Self-control over personal data	73	60	76	85	82	82	65	86	66	67	63
Access by government in emergencies	52	51	52	66	49	45	51	57	46	57	50
Usage by government	26	26	36	37	27	29	23	33	19	18	17
Usage by private companies	37	43	50	40	39	38	36	45	28	27	29
Major concerns related to sharing data in normal times											
Privacy violation	8.0	5.0	12	13	6.0	10	5.0	10	4.0	5.0	13
Identity theft	31	11	34	42	47	41	30	49	30	18	13
Scams or bank account data theft	37	65	41	23	35	16	32	27	38	53	36

Note: Percentages were calculated excluding cases with missing data and over smartphone users, individuals who used a smartphone in the week prior to the interview. Results at the region level correspond to the average across the 10 selected countries. For more details, see Appendix 2.

A minority of people were concerned about sharing data during normal times – privacy violation (8%), identity theft (31%), and scams or bank account data theft (37%) (see Table 2). However, only about 1 in 10 people felt the benefits of sharing personal data outweigh the risks in normal times (see Figure 1). This perception changed compared to sharing data during the pandemic (60%). Support for sharing data in a pandemic did not vary significantly across demographic groups (see Appendix 3, Table 2); the largest difference is only 7 percentage points, from about 56% among those over 60 years old to about 63% among those 18–30 years old. The other differences (in gender, education, or size of household) were equally insignificant. Differences across countries, however, were significant, ranging from 47% in Uruguay to 74% in Peru.

Figure 1. Perception of government's data usage with or without a pandemic (%)



Note: Percentages were calculated excluding cases with missing data. Results at the region level correspond to the average across the 10 selected countries. For more details see Appendix 2.

The survey also captured the acceptability of various digital interventions introduced during the pandemic. Around 70% of the individuals reported that they would use an application to report symptoms and 75% would use an app that accesses their location or uses AEN technology to alert them about possible exposure. These proportions were lower among older groups (see Appendix 3, Tables 1 and 2). Other contact-tracing strategies such as daily follow-up calls, tracking via GPS for quarantine enforcement, and daily visits to the population with or without the virus are the most popular measures for government authorities to mitigate the spread of the virus – 86%, 70%, and 68%, respectively. Among the least supported are electronic wristbands (49%) and a security guard at the door (38%) (see Table 3). In Uruguay and Costa Rica in particular, individuals over 40 years old with high education levels rejected electronic wristbands and security guards at door (see Appendix 3, Table 3).

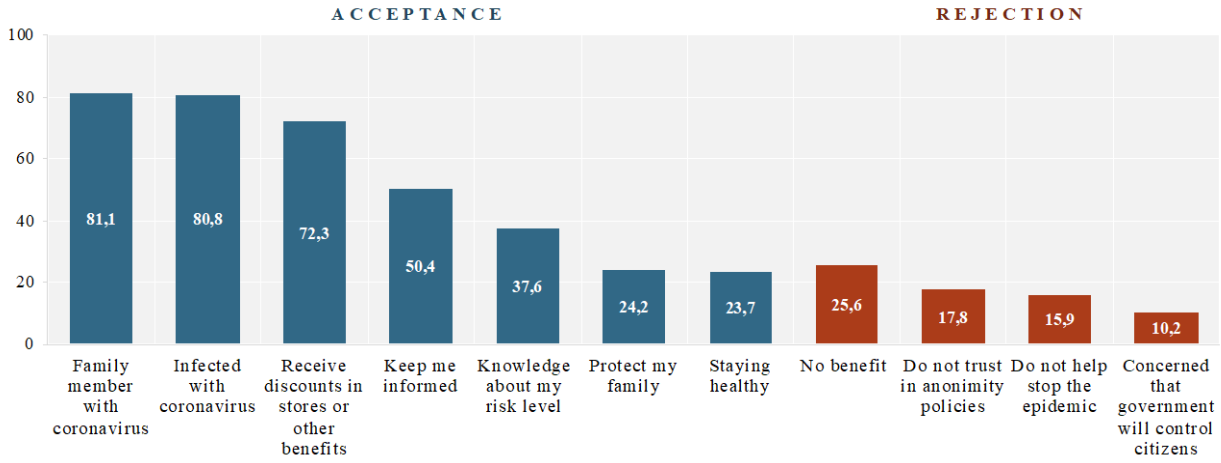
Table 3. Acceptance of technologies for COVID-19 symptom tracking, exposure, and quarantine enforcement (%)

	Region	CH	CR	ES	EC	HO	ME	PN	PE	PR	UR
Use app to report symptoms	71	71	63	81	71	69	72	71	82	64	64
Use app that alerts for possible exposure	75	80	66	85	72	71	75	78	83	70	76
Daily follow-up calls for quarantine enforcement	86	88	89	91	78	85	82	89	91	86	86
Daily visits for quarantine enforcement	68	68	65	75	70	76	50	80	84	59	59
Electronic wristbands usage for quarantine enforcement	49	54	38	55	53	49	43	63	59	50	30
Tracking via GPS for quarantine enforcement	70	64	61	73	78	66	60	78	79	70	68
Security guards at the door for quarantine enforcement	38	24	28	50	40	44	33	33	54	56	18

Note: Percentages were calculated excluding cases with missing data. Results at the region-level correspond to the average across the 10 selected countries. For more details see Appendix 2.

To encourage adoption of digital technologies, especially innovations, it is important to understand the factors that lead people to accept or reject them. When asked about different reasons for accepting installation of a contact-tracing app on their phone, people in the survey said they were more likely to do so to protect their family, stay healthy, or be informed about their level of risk. Helping population measures (such as controlling the pandemic or reducing the number of deaths among the elderly) on the other hand, were less frequently the reason given for individuals being willing to accept or install the app (see Figure 2; also Appendix 3, Table 6). In all countries, adoption was the most successful when individuals or their relatives reported they were infected with COVID-19, demonstrating how the experience of a risk can impact adoption (see Figure 2). Figure 2 also shows that citizen trust is directly associated with the likelihood of app uptake. Apps are more prone to be rejected when the end-user cannot perceive a benefit, does not trust anonymity policies, or is overly concerned about government surveillance.

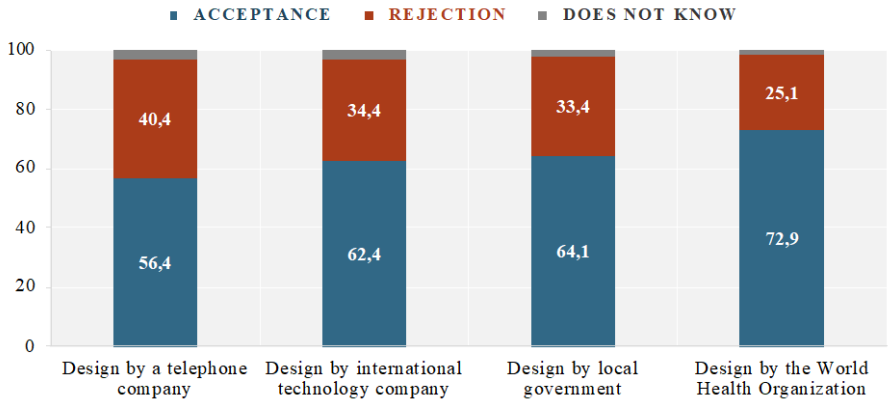
Figure 2. Principal reasons for acceptance and rejection of apps in the region: perceived benefits and risks (%)



Note: Percentages were calculated excluding cases with missing data. Results at the region-level correspond to the average across the 10 selected countries. For more details see Appendix 2.

Figure 3 shows that individuals in Latin America tend to trust more in an international organization than in the local government. Acceptance of an app design by the WHO is approximately 10 percentage points higher than one designed by local authorities. This gap is quite high in El Salvador (over 25 percentage points), and close to 13 percentual points in Honduras, and Mexico (Appendix 3 Table 7). By contrast, the difference is less than 3 percentage points in Chile, Costa Rica, and Panama. Technological solutions designed by a telephone company or an international technology company have the lowest rate of acceptance – 56% and 62%, respectively. When end-users receive discounts in stores or other benefits, the likelihood of acceptance also rises (72%).

Figure 3. Principal reasons for acceptance and rejection of apps in the region by app designers (%)



Note: Calculation of the percentages excluded cases with missing data. Results at the region-level correspond to the average across the 10 selected countries. For more details see Appendix 2.

Discussion

Countries introduced various digital interventions and innovations to support their citizens throughout the pandemic. However, to be effective, digital interventions must be widely adopted, and therefore it is critical to understand how citizens viewed the different components of the digital interventions (symptom tracking, exposure notification, quarantine enforcement, etc.). People have many reasons to accept or reject installing these technologies on their personal devices. In this study, we explored the beliefs and reported behaviors vis-à-vis the acceptance of various

digital technologies used to track the COVID-19 pandemic. These findings can help program designers and implementers understand contextual factors and percepts that could increase the usage and effectiveness of digital tools during pandemics or health emergencies in the region. This is especially relevant for digital innovations introduced under these circumstances, as technology quickly advances.

We found that the levels of general knowledge and use of digital technologies in Latin America are high. Among respondents, over 70% reported using a smartphone or other cellular device in the last week, suggesting substantial widespread comfort with digital devices. Use of digital payment technologies were lower (39% regionally) and varied by country. The survey was conducted early in the pandemic when most countries were beginning to launch their applications; nevertheless, only half of the respondents were aware of an application's availability in their country (47%).

Despite knowing about a government application to report symptoms (47%) and owning a digital device to use it (70%), few people reported installing the app (2%). This 2% may represent early adopters; the percentage for Uruguay in the survey in late July was 5%, but six months after this study was completed, adoption of the app in Uruguay had increased from 8.3% in August to 19% in December (Vitta, 2020; De Marco, 2020).[1] Based on this finding, public health authorities need to review the effectiveness of existing communication strategies and channels to quickly reach their populations with health information, such as instant messaging which was reported to be used by over 90% of the population in all countries surveyed.

Most citizens reported that during pandemics they were willing to share their data, even though they were unsure how it would be used by the government or by private companies. Respondents were almost six times more likely to be willing to share data during a pandemic compared to regular times, even though risks of sharing data during normal times were relatively high in most countries. Previous work has found that individuals are more likely to adopt innovative technologies if they know how their personal data is used (Horvath et al., 2022). In our study, however, 26% of people reported not knowing how the government would use their data while more than 70% would use an app to report symptoms and receive alerts for possible exposure during health emergencies.

Citizens in Latin America are also willing to use digital technologies during pandemics for symptom tracking, exposure notification, and quarantine enforcement. Those who are willing to use an app, however, are more likely to accept these technologies to protect their families and themselves. This finding is consistent with other studies showing that in developed countries, protecting family and friends is one of the main reasons to install a contact-tracing app (Altmann et al., 2020). The app designer also matters and affects the level of adoption of the app. In the countries surveyed, solutions designed by national governments and international organizations such as the WHO increase acceptance.

Overall, digital e-health technologies in Latin America are showing promising results and their deployment is likely to continue. However, in addition to citizens' acceptance of digital inventions, health systems need to be ready to adopt them. For example, the time lag between detection of possible infection and the sending of exposure notification by the public health authorities limited the app's perceived benefits, as information was not received in an actionable timeframe (Facchina, 2020; Dave, 2020; Aguilar, 2020). As governments implement new digital public-health services (such as digital COVID-19 vaccination certificates, lab results, and recovery status), this study highlights the importance of citizens' willingness to allow their personal data to be shared during the pandemic, their beliefs about the risks and benefits of these services, and preferences for and trust in who designs them. The latter is especially relevant as globally more than 75% of people strongly support mandatory use of COVID-19 passports to travel (Broom, 2021), and both Apple and Google have announced how health passes can be integrated into Apple Wallet or Google Pay and public-private partnerships between technology experts and trusted health authorities may affect user perception (Perez, 2021; Molina, 2021; Webster, 2921; Hardwick, 2021).

[1] In Uruguay, for example, by December 2020 more than half a million people had downloaded the contact-tracing app (Coronavirus UY), and more than 400,000 people activated the exposure notifications.

To our knowledge, this is the first regional study to document and examine the perceptions and reasons to accept digital technologies in Latin America during pandemics. The findings are particularly important given that some of these innovative technologies, such as AEN or GPS tracking, have not yet been used for public health in the region. These results are also likely to be relevant in the countries surveyed as well as in other countries with similar sociodemographic features, health systems, and health interventions during the pandemic.

The reliability of the data, however, is affected by the individuals' self-perception and the data-collection period. For future research, collection of updated data and further analysis is needed to identify possible changes in people's adoption, acceptance, and perceptions of the current stage of the pandemic. In addition, given the self-reported acceptance for the adoption of technology in the region, other factors not included in this study, such as cellphone space or data limitations, may play a role and need to be studied further. Also understanding the constraints of health systems to effectively adopt digital interventions for public health emergencies needs to be taken into consideration. Further research is also needed, including statistical models showing the potential correlation between early adopters of contact-tracing technologies with individual-level sociodemographic characteristics to understand adoption at the individual level; to better understand differences among countries; and to identify country-level factors such as political leanings, stringency level, trust, etc. (Boruchowicz, 2021).

Despite the study's limitations, taken together with other public health surveillance data, these insights can help policymakers understand people's perceptions in the context of health emergencies and help ensure a widespread uptake of existing and new technologies, including the COVID-19 digital vaccination certificate.

Data sharing

The data in this study is property of the Inter-American Development Bank. Restrictions apply to its availability, and it will not be made publicly available. The custom codes and dataset generated and analyzed in the study can be made available by the respective author via written request.

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Appendix

Appendix 1. Survey instrument

The survey included eight modules with questions about the individual's perceptions and sense of trust in the protection of data-privacy rights and use of technology, as well as basic sociodemographic indicators. Modules 1 and 2 included general questions about the individual (age, gender, education level) and household characteristics (household size, number of members under 12, number over 60 years old). Module 3 focused on general use of technology. Module 4 focused on the sense of trust and protection of data-privacy rights in the context of COVID-19. Module 5 included questions about the pandemic's impact on daily routines. Module 6 had questions about a hypothetical app from the national government that would not consume data and would notify users of suspected infection and next steps; also, respondents were randomly assigned to two app regimes: opt-in (download voluntarily) and opt-out (automatically installed). For our analysis, we did not differentiate between these two groups. Module 7 had questions about trust and technology in the context of COVID-19, and Module 8 about the individual's perceptions and behavior toward government restrictions and new technologies during the pandemic.

Appendix 2. Description of variables

For Table 2, the survey included three options for education level: i) "less than high school" for all individuals who did not attend school, attended but did not complete primary school, or completed primary school but did not complete high school; ii) "high school" for individuals who completed high school with no further schooling or who then attended but did not complete college; and iii) "more than high school" if an individual completed college (including those who also attended partial or completed postgraduate programs). In the category "percentage of households with members aged 60 years and older," respondents in that age range are included.

For Table 3, smartphone usage identifies individuals who in the week prior to the interview used a smartphone. Smartphone usage is defined as individuals who use their smartphone some days (or every day) for social-media apps, such as Facebook, Instagram, Twitter, and instant messaging (WhatsApp). In addition, individuals are considered to have knowledge about usage of personal data by government and private companies if they responded that they have full or intermediate knowledge. An individual is considered to use the government app if their response to this question – "What would you do if there is or was a national government app that you need to download to let you know if you have any symptoms related to COVID-19 and what to do next?" – indicated they had already installed the official app. It is worth noting that at the time of the survey, El Salvador and Honduras did NOT have an app, and Ecuador released ASI (a digital contact tracing application via Bluetooth) on 14 August 2020, ten days after the survey began. An individual is considered to have self-control over personal data if he / she responded affirmatively to the question: "Do you consider you have control over your personal data?" Finally, an individual is considered to have knowledge of the government accessing their data in emergencies if he / she gave a positive response to the question: Based on what you know, can the government legally use your personal data in emergencies?

For Figure 1, an individual is considered to be willing to share data when he or she considers that sharing personal data has more benefits than risks. An individual is considered to be willing to share data during a pandemic when he / she considers that the benefits of sharing personal data with the government outweigh the potential risks during a pandemic.

For Table 4, we calculated the proportion of individual who would use an app to report symptoms and/or that shares alerts for possible exposure as individuals who claimed they would or probably install or not uninstall an app to report symptoms or that alerts for possible exposure. Percentages calculated over smartphone users, individuals who used a smartphone in the week prior to the interview. The share of acceptability of technologies for COVID-19 (such as daily follow-up calls, daily visits for quarantine enforcement, electronic wristband, tracking via GPS, and security guards at the door for quarantine enforcement) were calculated over the total sample.

In Figure 2 and 3, acceptance refers to individuals who reported they would (or probably would) install or not uninstall a government app. Rejection refers to individuals who claimed they would not install or uninstall a government app.

In Figure 3, an international technology company refers to companies such as Apple or Google. Discounts in stores or other benefits refer to discounts offered in commercial venues (retail stores, restaurants, etc.) to individuals who have the app installed on their cell phone. Design by local government includes departmental, state, provincial and/or municipal level.

Appendix 3. Supplementary results

Table 1. Sample characteristics

	Region	CH	CR	ES	EC	HO	ME	PN	PE	PR	UR
Demographic characteristics											
Sample (n)	10,257	1,004	1,000	997	1,000	1,000	1,214	1,000	1,009	1,021	1,012
Age (mean)	42	44	43	41	42	40	43	43	41	38	46
Age (SD)	16	17	15	15	16	15	16	16	16	16	18
Gender (% female) ˣ	51	51	53	54	51	54	46	49	51	50	53
Educational level (%)											
Less than high school ˣ	49	36	54	62	45	71	46	46	23	50	56
High school *	34	41	25	29	45	24	25	35	54	33	32
More than high school ˣ	17	23	20	8	11	4	29	19	24	16	12
Household composition											
Size (mean)	4.0	4.0	4.0	4.0	4.0	5.0	4.0	4.0	5.0	4.0	3.0
Size (SD)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	3.0	2.0	3.0
Includes members <12 (%) ˣ	47	38	40	54	49	63	40	46	55	54	30
Includes members >60 (%) ˣ	39	40	36	42	40	34	37	45	44	34	38

Note: Percentages were calculated excluding cases with missing data. Results at the regional level correspond to the average across the 10 selected countries. For more details, see Appendix 2.

* The proportion of cases in at least one country differ from the others by a 5% significance level.

Table 2. Perception of government's use of data with or without a pandemic (%) by demographic categories

	Region	CH	CR	ES	EC	HO	ME	PN	PE	PR	UR
In general, the benefits of sharing data outweigh the risks											
Age group											
18–30	10.3	7.3	9.1	18.4	7.8	9.0	9.8	5.0	10.2	9.8	16.3
31–40	9.6	6.4	7.0	13.8	6.3	15.3	8.2	4.2	13.3	8.9	12.8
41–50	9.3	4.2	5.6	15.7	5.3	4.0	7.1	13.5	14.6	11.8	11.0
51–60	13.5	5.0	5.4	20.1	27.9	15.9	10.8	7.2	21.4	14.7	7.7
60+	11.4	7.6	6.6	21.0	7.3	10.2	13.0	11.6	16.1	12.3	10.6
Gender											
Female	9.6	5.9	6.1	15.3	12.0	10.1	8.4	4.7	10.8	11.3	11.2
Male	11.7	6.7	8.0	20.2	9.0	11.4	10.7	10.9	17.4	10.3	12.8
Education level											
Less than high school	11.4	4.7	5.4	19.5	14.2	12.8	10.5	9.4	17.0	10.8	9.5
High school or more	9.8	7.2	9.1	14.4	7.6	5.7	8.8	6.1	13.1	10.6	15.1
Household composition											
Includes members < 12	9.7	8.2	6.4	16.9	7.3	13.3	7.9	2.1	13.5	8.6	11.5
Includes members >60	10.9	7.8	7.1	20.7	11.6	14.5	8.1	7.1	12.9	8.9	9.8
The benefits of government collecting personal data during pandemic outweigh the risk											
Age group											
18–30	62.9	64.1	57.0	62.5	72.0	50.2	60.8	70.3	71.3	68.2	50.0
31–40	62.4	69.4	58.1	70.6	56.6	62.5	57.9	58.3	73.4	60.5	55.9
41–50	61.9	67.7	57.1	60.7	70.6	64.5	63.5	58.5	78.6	51.0	47.1
51–60	57.5	66.6	54.5	59.1	56.8	54.0	54.4	65.0	74.6	51.6	41.7
60+	56.3	55.8	46.1	68.8	68.1	48.9	60.1	57.0	72.4	49.2	41.4
Gender											
Female	59.3	65.4	54.8	63.2	69.6	51.4	56.1	59.6	72.9	56.4	44.2
Male	62.3	63.6	55.8	65.1	61.8	60.8	62.3	65.3	74.4	62.6	50.2
Education level											

	Region	CH	CR	ES	EC	HO	ME	PN	PE	PR	UR
Less than high school	59.0	61.1	51.7	66.6	62.7	55.8	60.7	65.4	75.2	57.6	45.2
High school or more	62.4	66.4	59.2	59.9	68.3	55.8	58.5	59.9	73.2	61.4	49.3
Household composition *											
Includes members <12	61.9	68.8	56.9	66.6	69.4	54.5	56.6	57.5	73.4	58.7	54.0
Includes members >60	61.3	64.5	57.1	66.2	64.4	49.0	61.1	68.2	72.6	57.8	43.8

Note: Percentages were calculated excluding cases with missing data. "Region" column averages the results across the 10 selected countries. For more details see Appendix 2.

Table 3. Acceptance of technologies for COVID-19 symptom tracking, exposure and quarantine enforcement (%) by demographic categories

	Use app to report symptoms	Use app that alerts for possible exposure	Daily follow-up calls for quarantine enforcement	Daily visits for quarantine enforcement	Electronic wristbands usage for quarantine enforcement	Tracking via GPS for quarantine enforcement	Security guards at the door for quarantine enforcement
Age group							
18–30	75.0	81.8	89.6	63.8	54.3	68.0	41.7
31–40	71.2	75.2	86.3	68.3	47.2	68.0	35.9
41–50	69.0	71.7	86.6	70.6	49.1	70.6	34.2
51–60	65.3	70.2	85.1	72.7	45.8	72.2	36.7
60+	64.7	66.9	81.0	68.1	45.2	70.7	38.4
Gender							
Female	71.0	76.8	87.4	70.3	51.2	68.7	37.8
Male	70.5	74.1	85.2	65.9	47.3	70.4	37.9
Education level ×							
Less than high school	70.0	71.5	85.7	68.3	49.4	71.5	46.3
High school or more	71.3	78.3	87.0	67.9	48.9	67.7	30.0
Household composition *							
Includes members < 12	72.1	76.5	87.4	69.2	50.4	70.1	40.6
Includes members > 60	72.4	77.1	86.0	69.5	49.2	69.6	36.6

Note: Percentages were calculated excluding cases with missing data. Region corresponds to the results across the 10 selected countries. For more details see Appendix 2.

Table 4. Other risks from sharing data in normal times (%)

	Region	CH	CR	ES	EC	HO	ME	PN	PE	PR	UR
Sale to a third party	1.1	1.2	1.0	1.3	0.9	1.0	1.9	2.0	0.1	0.5	1.0
Discrimination by any government entity	0.8	0.5	1.9	0.9	0.3	0.7	0.7	1.4	0.1	0.9	0.5
Discrimination by any private companies	0.5	0.9	0.5	0.3	0.1	0.7	0.1	0.8	0.1	0.9	0.6
Unwanted marketing	1.0	0.8	0.9	0.6	0.4	0.3	1.5	0.9	0.7	1.7	1.7

Note: Percentages were calculated excluding cases with missing data. Region corresponds to the results across the 10 selected countries. For more details see Appendix 2.

Table 5. Reasons for acceptance of technologies for positive cases of COVID-19 (%)

	Region	CH	CR	ES	EC	HO	ME	PN	PE	PR	UR
Positive cases											
Daily follow-up calls	88.5	90.1	86.6	91.9	87.5	87.3	83.1	92.4	91.9	85.0	90.0
Daily visits	70.0	72.9	71.5	72.9	62.8	82.0	50.8	84.0	87.2	56.3	62.4
Tracking via GPS	51.5	51.5	40.6	55.8	55.8	50.6	42.8	62.5	66.4	52.8	36.7
Security guards at the door	69.0	68.1	61.2	76.4	76.8	67.8	53.0	72.1	82.3	67.1	67.6
Electronic wristband usage	38.7	29.6	28.5	40.7	36.8	51.8	36.2	35.0	55.5	51.8	21.3

Note: Percentages were calculated excluding cases with missing data. The region column averages the results of the 10 selected countries. For more details see Appendix 2. Acceptance refers to individuals who claimed they would (or probably would) install and would not uninstall a government app.

Table 6. Reasons for acceptance and rejection factors of apps in the region – perceived benefits & risks (%)

	Region	CH	CR	ES	EC	HO	ME	PN	PE	PR	UR
Acceptance factors											
Knowledge about my risk level	37.6	38.3	37.7	31.4	38.3	34.2	30.3	45.2	40.6	56.8	30.3
Infected with coronavirus	80.8	85.5	75.2	86.7	72.5	73.4	83.2	84.0	87.2	77.1	85.1
Family member with coronavirus	81.1	84.9	74.4	88.7	74.3	75.1	81.3	83.5	87.4	79.0	84.3
Staying healthy	23.7	11.9	25.6	24.8	17.6	16.6	25.6	38.5	14.0	56.8	10.3
Protect my family	24.2	20.3	29.2	17.0	17.1	14.5	17.3	46.3	12.6	61.1	14.9
Keep me informed	50.4	45.2	55.0	50.2	40.7	50.0	39.0	57.4	53.9	71.6	49.1
Feeling of tranquility	8.6	2.2	8.1	3.5	1.9	2.1	2.2	23.9	4.6	45.3	1.6
Responsibility to the community	15.2	8.9	16.4	10.8	7.0	7.1	7.6	32.0	5.5	47.8	15.8
Reduce number of deaths among the elderly	7.4	1.4	7.8	0.6	0.2	0.4	1.3	27.0	0.3	43.0	0.5
Help stop the pandemic	11.6	4.4	10.4	4.2	10.3	4.4	6.1	30.8	4.1	44.1	3.2
Rejection factors											
Infected with coronavirus	17.0	13.5	20.7	11.4	26.3	24.3	16.2	12.4	11.6	18.0	13.5
Family member with coronavirus	16.6	13.9	22.1	10.3	24.4	22.2	16.8	11.5	11.9	17.5	14.2
Does not help stop the epidemic	15.9	4.2	25.6	31.0	7.4	7.3	15.5	33.9	2.8	23.4	7.1
Does not know how to install applications	5.8	0.0	5.4	3.9	0.3	3.2	0.0	7.9	4.0	27.1	1.4
Complicated or no space to install it	9.0	2.9	12.0	1.7	6.4	7.9	6.5	10.1	8.1	26.3	0.0
No benefit	25.6	30.1	24.2	21.3	28.0	31.7	30.4	15.9	10.4	35.3	14.8
Concerned that phone may be compromised	8.9	4.5	11.7	2.3	5.6	12.6	2.7	13.6	2.5	22.3	3.4
Concerned that government will control citizens	10.2	14.1	12.9	9.4	4.5	3.2	7.8	16.0	4.6	24.6	3.3
Avoid anxiety	8.6	4.6	5.7	5.5	10.7	6.2	5.0	12.9	6.3	14.9	10.8
Does not want to share location withe government	10.1	16.0	11.5	8.0	5.1	2.8	4.3	15.5	5.2	21.4	10.5
Does not trust anonymity policies	17.8	11.0	30.4	16.7	25.7	6.2	26.9	20.7	6.0	13.9	8.3

Note: Percentages were calculated excluding cases with missing data. Region corresponds to the results across the 10 selected countries. For more details, see Appendix 2. Acceptance refers to individual who claimed they would or probably would install and would not uninstall a government app. Rejection refers to individual who claimed they would not install and would uninstall a government app.

Table 7. Reasons for acceptance and rejection factors of apps in the region – contextual factors (%)

	Region	CH	CR	ES	EC	HO	ME	PN	PE	PR	UR
Acceptance % of people											
Discounts in stores or other benefits	72.3	68.2	66.8	85.5	74.2	71.8	74.0	79.2	75.7	69.9	56.1
App designed by local government	64.1	71.9	63.2	53.6	68.5	62.2	65.3	65.1	66.2	62.5	64.2
App designed by international technology company	62.4	62.5	58.4	64.0	65.1	61.2	63.5	71.4	65.8	58.1	53.1
App designed by a telephone company	56.4	49.7	54.6	55.7	56.1	59.0	57.7	62.0	56.6	56.4	55.2
App designed by the World Health Organization	72.9	72.5	65.3	80.8	70.8	75.5	78.8	68.0	73.0	71.8	71.6
Rejection factors											
Discounts in stores or other benefits	24.4	28.2	28.6	12.9	25.4	25.9	23.7	14.9	22.8	24.4	38.2
App designed by local government	33.4	26.4	31.5	44.8	30.9	35.0	33.6	29.4	33.6	34.3	33.1
App designed by international technology company	34.4	36.6	36.0	34.5	34.2	32.0	35.2	24.3	33.9	36.2	41.8
App designed by a telephone company	40.4	48.5	39.3	42.7	43.3	38.7	40.8	30.3	41.9	38.6	40.8
App designed by the World Health Organization	25.1	25.8	30.5	17.8	28.7	22.4	20.5	29.2	26.9	24.7	25.5

Note: Percentages were calculated excluding cases with missing data. Region corresponds to the results across the 10 selected countries. For more details see Appendix 2. Acceptance refers to individual who claimed they would or would likely install or not uninstall a government app. Rejection refers to individual who claimed they would not install or uninstall a government app.