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Acceptability of m-Health Solutions and its Relationship with Public Trust

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Abstract

Mobile devices with health-related apps hold the potential for increasing the quality and efficiency of healthcare services. Two years of the COVID-19 pandemic have put additional stress on already struggling healthcare systems around the world, representing an opportunity for digital tools and e-health solutions to step in. This paper analyses acceptability of three mobile health solutions in Croatia and its relationship with public trust. Each of the apps, Health Portal, Stop COVID-19 and CovidGO, had their own paths to the users, paved by provided information, promotion existence and dynamics, as well as the impact of public actions, such as media appearances of authority figures mentioning the apps. Health Portal and Stop COVID-19 apps gained momentum as well as the national uptake of EU digital COVID certificates, for which CovidGO app was instrumental. Needing to use one app, users realized there are other m-health apps published by the Ministry of Health at the global app stores, which many chose to download as well. This demonstrates a certain level of citizens' trust to the offered solutions.

Introduction

The United Nations 2030 Agenda for Sustainable Development (UN, 2015) emphasizes that "the spread of information and communications technology (ICT) and global interconnectedness has great potential to accelerate human progress, to bridge the digital divide and to develop knowledge societies". World's population using the Internet since 2019 until 2021 increased by 17%, representing 782 million people estimated to have come online during that period and resulting in approximately 4.9 billion people or 63% using the Internet, mostly covered by a mobile-broadband signal (ITU-D, 2021). Therefore, global usage of mobile devices with health-related apps represents a great potential for increasing the quality and efficiency of healthcare services, also overcoming barriers to access, which has been recognized as one of the permanent challenges for health systems worldwide.

The World Health Organization (WHO) defines mobile health or m-health as a component of electronic health or e-health (WHO, 2011) and a "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices". The WHO Executive Board has also defined digital health as "often used as a broad umbrella term encompassing e-health as well as developing areas such as the use of advanced computing sciences (in the fields of big data, genomics and artificial intelligence, for example)" (WHO, 2017).

When it comes to assessing health interventions, including digital ones (e. g. m-health), acceptability has been defined within the theoretical framework of acceptability (TFA) as a "multi-faceted construct that reflects the extent to which people delivering or receiving a healthcare intervention consider it to be appropriate, based on anticipated or experienced cognitive and emotional responses to the intervention" (Sekhon et al., 2017). TFA consists of seven component constructs: affective attitude, burden, perceived effectiveness, ethicality, intervention coherence, opportunity costs, and self-efficacy.

Research on technology acceptance go more than three decades back. The Technology Acceptance Model (TAM) and TAM2 deal more specifically with the prediction of the acceptability of an information system determined by two main factors: perceived usefulness and perceived ease of use (Davis et al., 1989). The Unified Theory of Acceptance and Use of Technology (UTAUT) and UTAUT2 explain and predict the acceptance of technology firstly in an organizational context (Venkatesh et al., 2003), with many later additions and evolution of these models.

While both models aim at understanding better why users accept or reject a given technology, and how user acceptance can be improved through technology design, recent reviews show that "TAM and UTAUT failed to provide stable predictive capabilities for acceptance and use of technologies in health care" (Ammenwerth, 2019), with possible reasons specific for healthcare, where technology acceptance is influenced by socio-organizational and cultural factors.

Motivation and related work

With global spread of SARS-CoV-2 and the COVID-19 pandemic outbreak at the beginning of 2020, the usage of digital tools for enabling healthcare and related services gained in importance to patients as well as health professionals globally. Before the pandemic, "the greatest barriers to adoption of digital health tools were not primarily technical in nature, but instead lay in successfully facilitating the required individual, organizational and system changes" (Fahy and Williams, 2021). The same report recognizes four main areas digital health tools have been used during the pandemic: "support four main areas: communication and information, including tackling misinformation; surveillance and monitoring; the continuing provision of health care such as through remote consultations; and the rollout and monitoring of vaccination programs".

However, countries rushed deployment and adoption of such solutions raises profound concerns about surveillance, privacy and data protection. The case study (Newlands et. al., 2020) on digital surveillance technologies implemented during the COVID-19 pandemic delineates "the contextual nature of privacy trade-offs during a pandemic" exploring "how regulatory and technical responses are needed to protect privacy in such circumstances". The same study stated, "greater effort in incorporating privacy considerations beforehand in the design of digital solutions is very much needed, as afterthought privacy reflections risk exposing the health of citizens, wasting public resources and worsen the consequences that the state of emergency already has for society".

National health systems, such as the one in Croatia (Capak et al., 2020), as well as international collaborative initiatives, such as the eHealth Network of the European Union (eHealth Network, 2022), have increasingly developed and launched digital health tools in response to COVID-19. The European Commission (EC) and the EU member states have worked together to improve the efficiency of contact tracing and warning apps in 2020 and have defined a common approach for uniform and interoperable proofs of vaccination, testing, and recovery from COVID-19 via EU Digital COVID Certificates (EU DCC) in 2021. For the later, detailed technical specifications of the trust framework have been worked on jointly and reference implementations published as an open source. Clear trust framework allowed many (40, until end May 2022) third countries to join the EU DCC system.

This paper provides an insight in acceptability of three m-health apps implemented by Croatia. m-Health in Croatia is defined by the Healthcare Act ("The Official Gazette", No. 100/2018, 125/2019, and 147/2020) as "the use of mobile devices to collect medical and public health data. The application of m-health implies the use of mobile communication devices for the collection of general and clinical health data, the transfer of health information to physicians, researchers and patients, and remote monitoring of medical parameters of the patient".

Methods and tools

The first three m-health apps published and upgraded by the Croatian Ministry of Health during 2020 and 2021, as shown in Fig. 1, on two of the biggest mobile apps platforms (stores) worldwide, Google Play and App Store, were the following:

- Health Portal – Croatian patient portal app, providing citizen's access to personal health data from the electronic health records (EHR), among others: COVID-19 vaccination and testing records, making a COVID-19 vaccination appointment, messages exchange with the chosen doctors, lists of e-prescriptions dispensed and e-referrals issued, as well as medical reports received from primary care laboratories and specialists,

- Stop COVID-19 – Croatian COVID-19 warning and exposure notification app, for anonymous exchange of random encrypted strings via Bluetooth Low Energy (BLE) protocol, fetching the list of strings from infected persons, processing the data in a decentralized manner – on the device in order to find a match and solidary warn the contacts of the infection risk,

- CovidGO – Croatian EU DCC verifying app, with functionalities of reading and decoding QR codes from the COVID certificates and verifying the digital signature of the issuer, as well as the wallet for safe storage of EU DCCs. The app is cross-border interoperable for fetching signature keys.

When the timeline of all three m-health apps releases (launches) and major upgrades have been analyzed, along with other public actions, compared to the apps download statistics from Google Play (Android), as shown in Fig. 1, it can be seen that each of the apps have the unique path. Only Google Play (Android) download statistics have been used for the analysis, because it has shown sufficient for recognizing trends, as approx. 84% of app users are Android users.

The insightfulness of such an analysis depends of how many public actions have been pointed out, which served as triggers for statistics numbers to change course or dynamics. One of the public actions had been the health minister promoting "Stop COVID-19" app on November 19, 2020, which caused significant increase in the app' downloads.

In order to assess the acceptability of these official Croatian m-health solutions, a short online survey using Google Forms has been prepared with five questions on demography and seven questions on the use of mobile devices and m-health apps. The survey questions focused only of perceived and experienced usefulness, not covering the other aspects provided by the TAM/TAM2 or UTAUT/UTAUT2 models. The survey results have been shown in Fig. 2 and Fig. 3. and detailed in the next section.

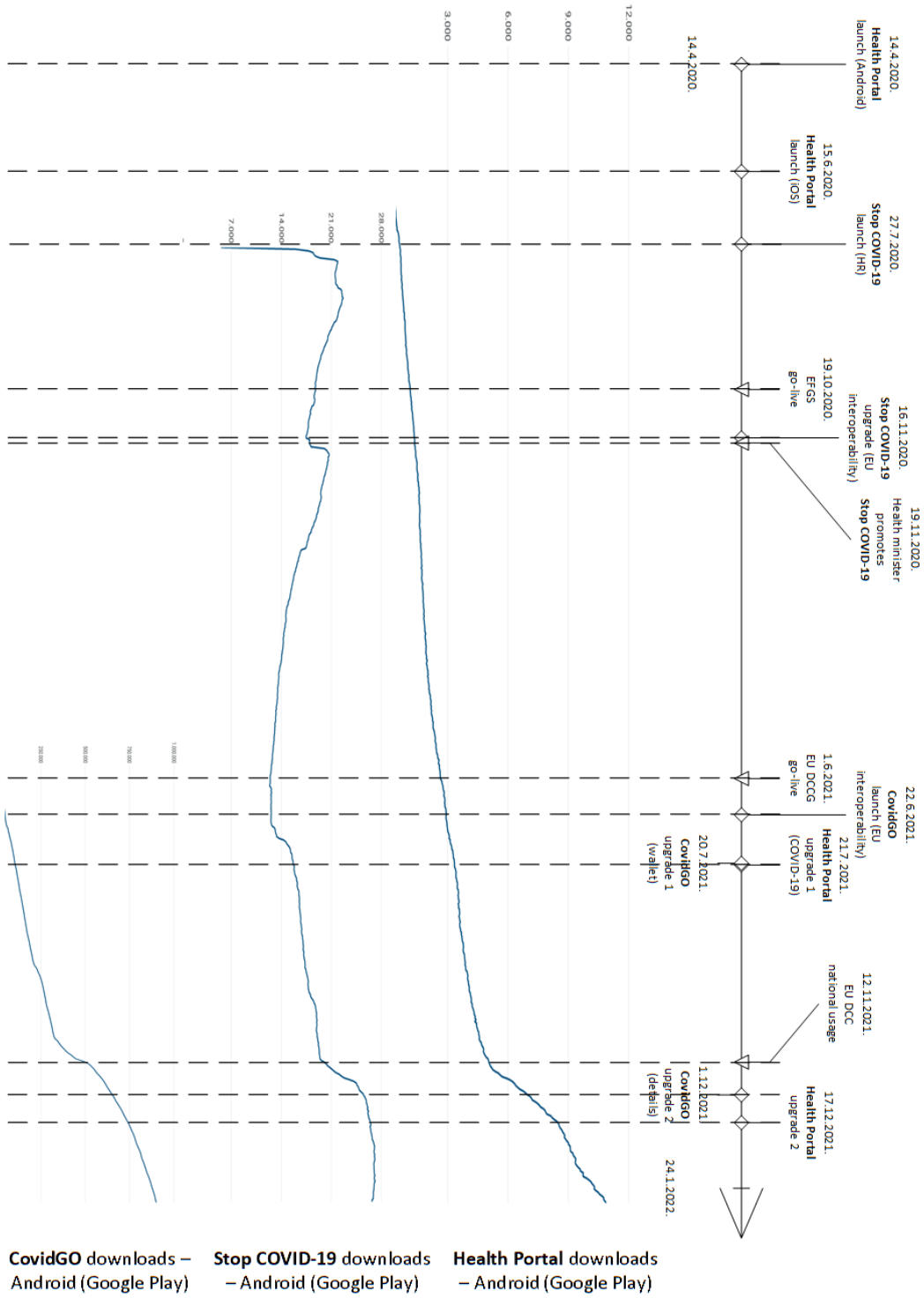


Figure 1. The timeline of the m-health apps releases (launches) and major upgrades, along with other public actions, compared to the apps download statistics from Google Play (Android).

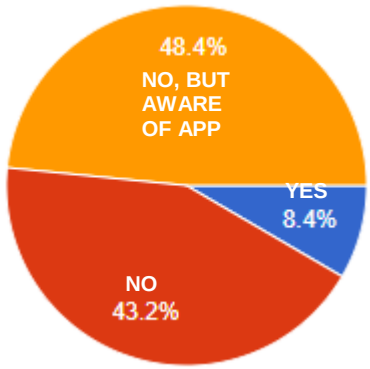
Results and discussion

The online survey was active from November 30, 2011 until January 24, 2022, 55 days in total, and was presented to three cohorts of respondents from the University of Zagreb:

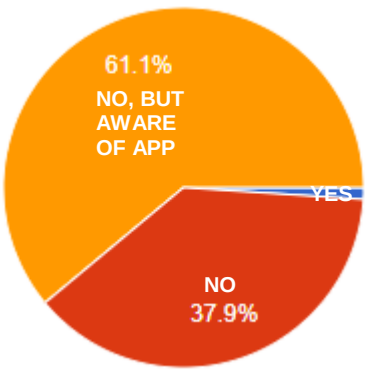
- 2nd year's graduate students of EE and computer science attending Biomedical Informatics course at the Faculty of EE and Computing,
- 3rd year's graduate students of pharmacy attending Pharmaceutical Informatics course at the Faculty of Pharmacy and Biochemistry,
- 1st year postgraduate specialist students of epidemiology from Medical Informatics course at the School of Medicine.

The results of the 95 responses showed that almost 98% of respondents owned a mobile phone capable of using the apps from the stores. Around 2/3 of respondents were female, while 1/3 were male. Regarding the age group distribution, 63.2% of respondents were 21-25 years old, 17.9% were 16-20, 8.4% were 31-40, 7.4% were 26-30, 2.1% were 41-50 and 1% were 51-60.

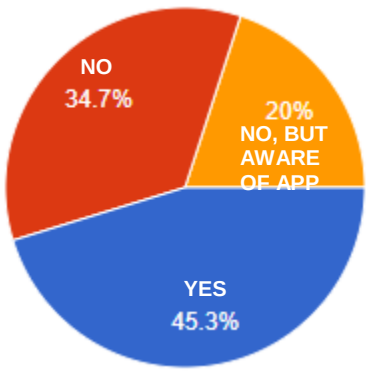
a) Do you own a smart phone?



b) Have you installed Health Portal app?



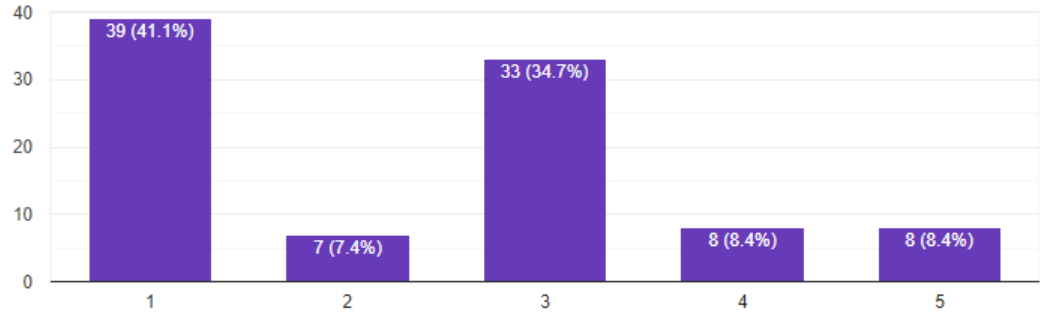
c) Have you installed Stop COVID-19 app?



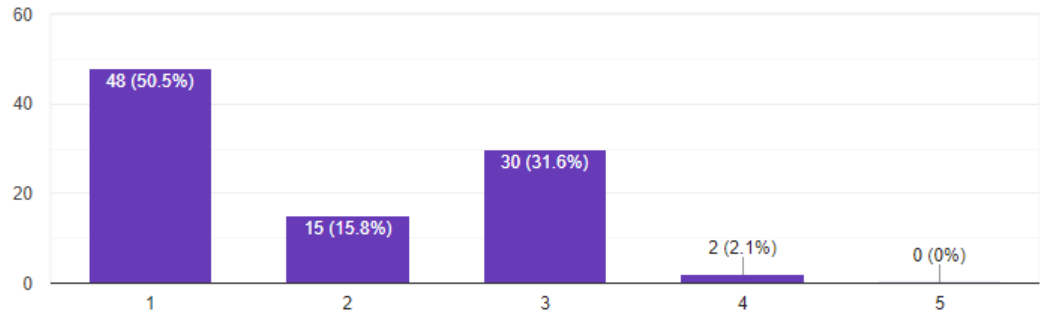
d) Have you installed CovidGO app?

Figure 2. The survey answers (N=95) about owning a smart phone and installing m-health apps.

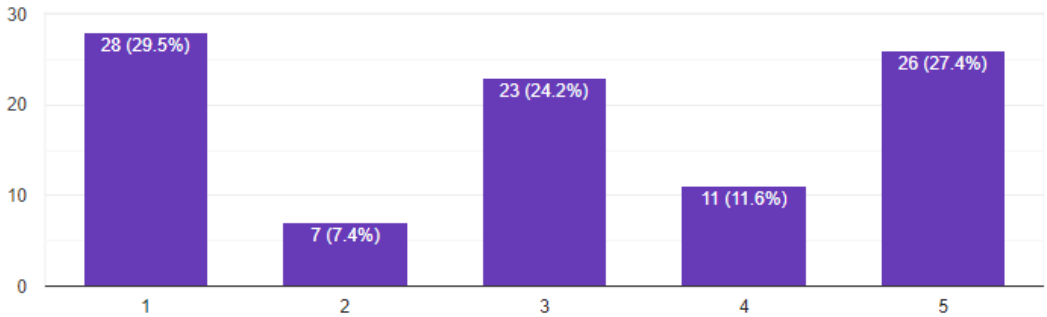
As the survey answers show in Fig. 2, around 2/3 of respondents were aware of CovidGO app and 45.3% of them installed it, which makes sense because the app has been regularly promoted in the media and among citizens affected by the need to use EU DCCs for crossing the EU borders and later even nationally. Health Portal app was installed by 8.4% of respondents, without any organized public promotion, but being an additional user interface to the existing web application known to citizens. The least installations (1%) were done with Stop COVID-19 app, without any public promotion at all and with some bad publicity non-justifiably lagging from before launching the app when the public trust was lost.



a) How much have you found Health portal app useful? (1 – not at all; 5 – completely useful)



b) How much have you found Stop COVID-19 app useful? (1 – not at all; 5 – completely useful)



c) How much have you found CovidGO app useful? (1 – not at all; 5 – completely useful)

Figure 3. The survey answers (N=95) about the degree of usefulness of the apps (Likert scale).

Survey answers in Fig. 3 support the ascertainment that CovidGO app has been found as the most useful to respondents (with 3 points average). Health Portal app was somewhat useful to respondents (with 2.4 points average), while Stop COVID-19 app was found not much useful to respondents (with 1.9 points average).

Conclusion

Although all three apps had dedicated web pages (Health Portal, 2020) (Stop COVID-19, 2020) (EU DCC, 2021), those were not instrumental in gaining public trust. Health Portal app had a steady, organic growth in acceptability by the users during 2020 and 2021. Stop COVID-19 publicity was damaged before the app was launched, due to efforts by the authorities to propose legislative changes that would allow launching a quarantine management app and consequent concerns over intrusion to user privacy. Appreciable uptake of CovidGO app was guided by the decisions of the Civil Protection National Headquarters, authorized by the law to introduce epidemiological measures and restrictions during COVID-19 pandemic.

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