



***WORKING PAPER SERIES***

# **Mobile Health: Ensuring healthy lives and well-being for all.**

**The Competitive Intelligence Unit**

## Abstract

This paper discusses the importance of the mobile health (mHealth) in the provision of healthcare, and after reviewing important aspects of its implementation, provides recommendations to strength the mHealth ecosystem for Mexico.

To achieve that, this document contrasts different definitions to obtain a comprehensive view of mHealth. It also reviews several use cases to show potential replicable direct benefits of mHealth in patients, improvement in treatment and in attendance to medical appointments as well as modifications in user behavior such as losing weight or reducing tobacco consumption. To replicate such use cases, it is required an important level of adoption of mobile technologies.

This paper discusses some statistics regarding the mobile market (software and devices) to explore the readiness level of the Mexican population to adopt mHealth solutions. The massification in the adoption of Smartphones is already a reality in Mexico, while despite the slowdown in the rate of increase of apps users during the last six years, in the period 2020-2021 there was an important increase of 5.9%, more than twice the rate from the immediate period before.

The paper also reviews the supply of mobile apps for patients. This mapping revealed that 86% of the available apps comes from private sector while 14% is managed by public institutions.

One of the most successful cases in Mexico for its wider spread is IMSS Digital, the app from the Instituto Mexicano del Seguro Social (IMSS) which accounts for 8.6 million of downloads, close to 17% of IMSS total users, with an annual increase of 41% in the period 2019-2020.

Regarding mHealth offer for clinicians, the paper also finds out that, according to the WHO, the most widespread solution based on ICT for health is teleradiology (reaching up to 77% of WHO members). Telepathology, remote patient monitoring and tele dermatology are also popular.

Due to its relevance, this paper reviews local and international experience regarding the use of mHealth solutions in the face of COVID-19 pandemic. From that experience, it stands out that they work as a complementary tool of health policy giving users information to prevent the spread of the virus and connecting doctors and patients to treat symptoms of the disease.

Subsequently, by analyzing the results of an independent survey, the paper explores the adoption challenges of mHealth solutions. The most frequent reasons deterring the use a mHealth device is cost, followed by lack of knowledge and, in third place, concern regarding privacy and data access.

Additionally, the document discusses two identified barriers for adoption: connectivity and interoperability. Besides the current digital gap that accounts for 48% of the households in Mexico, interoperability needs to be addressed in the current legal

framework. This document also reviews an initiative in the Senate aimed at promoting and defining quality standards for telemedicine and interoperability. This initiative also provides CENETEC (National Center of Technological Excellence in Health) powers to implement and sanction violations to the proposed Digital Health Law.

Considering the previous framework, a solid mHealth ecosystem in Mexico would require:

- Understand the complementary nature of mHealth solutions. Mobile technologies contribute to provide better healthcare services since they provide patient's monitoring capacity, and more efficient use of healthcare resources, among other benefits.
- Encourage digital health ecosystem development through collaboration mechanisms between private and public initiatives to promote the creation, adoption, and improvement of mHealth solutions such as apps related to wellbeing and patients monitoring.
- Take advantage of the high adoption of mobile technologies in Mexico to encourage the use of mHealth solutions among patients and clinicians.
- Implement an ICT affordability policy to tackle cost-related barriers. The CIU has developed a series of recommendations: i) tax policy that reduces the purchase price to consumers, ii) subsidies from government to promote adoption in targeted social groups, and iii) low interest rate public loans, and government acting as joint guarantor for private loans, both instruments aimed at acquiring mobile devices.
- Development of mHealth public policies including improvement of digital skills among population and promotion of an app economy.
- Update current regulation (NOM-035-SSA-2013) to consider health information from mobile technologies as actual health information. This would facilitate the protection of users' information since NOM-035 establishes a data protection regulatory framework.
- Great care should be taken on regulation attempts regarding medical software: if its scope includes devices (such as smartphones or wearables) as medical devices their adoption and accessibility can be negatively impacted.
- Define quality standards for telemedicine, mHealth solutions, and systems of healthcare information to guarantee interoperability.

All this effort will translate into new spaces of opportunity both for public and private initiatives to respond the increased demand of healthcare services. As it can be seen from Digital IMSS example, it would be the first step to save resources to healthcare institutions reducing unnecessary procedures and improving administrative tasks, creating a cost-effective solution to healthcare provision. As well as paving the way to include mHealth into the digital economy.

Finally, on the side of the demand it would mean the chance to work towards UN goal to reach universal healthcare since mHealth is a synonym of ensuring healthy lives and well-being for all.

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## 1. Introduction

One of the UN Sustainable Development Goals for 2030 is to “Ensure healthy lives and promote well-being for all at all ages”.<sup>1</sup> Nevertheless, the current pandemic and economic recession threaten its accomplishment. Conditions are more severe in the Global South where access to healthcare is not universal and where more people live in poverty creating a complex scenario for healthcare institutions and governments.

The World Health Organization (WHO) affirms that universal health coverage will not be achieved without the support of eHealth.<sup>2</sup>

eHealth is the cost-effective and secure use of ICT in support of health and health-related fields, including health-care services, health surveillance, health literature, and health education, knowledge and research” (World Health Assembly, 2005).

Some forecasts affirm that the estimated global mobile health (mHealth) market in 2025 will reach \$189bn USD.<sup>3</sup> Some of the main drivers of this growth is the increased demand for mHealth linked to the perception of reduced costs to access healthcare with this kind of tools.

This working paper analyses mHealth (constituent part of eHealth) as a solution to expand healthcare access in a portable and cost-efficient way. The document is divided in six sections. The first section introduces a definition of mHealth and provides several examples of its implementation. The second section addresses the availability of health-related apps for patients in the Mexican market taking special interest in IMSS Digital. The third section focuses on analyzing apps for clinicians describing the positive impacts they have on healthcare services. The fourth section introduces a list of efforts involving mobile apps carried by governments around the world and within Mexico to address COVID-19 pandemic. In the fifth section the challenges to adopt mHealth are discussed from institutional and consumer-driven perspectives. Finally, in the sixth section provides final remarks.

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<sup>1</sup> United Nations, Goal 3, 2021. Available at: <https://sdgs.un.org/goals/goal3>

<sup>2</sup> Global Observatory of eHealth, "Global diffusion of eHealth: Making universal health coverage achievable", WHO, 2016. Available at: <https://bit.ly/3xBGsH5>

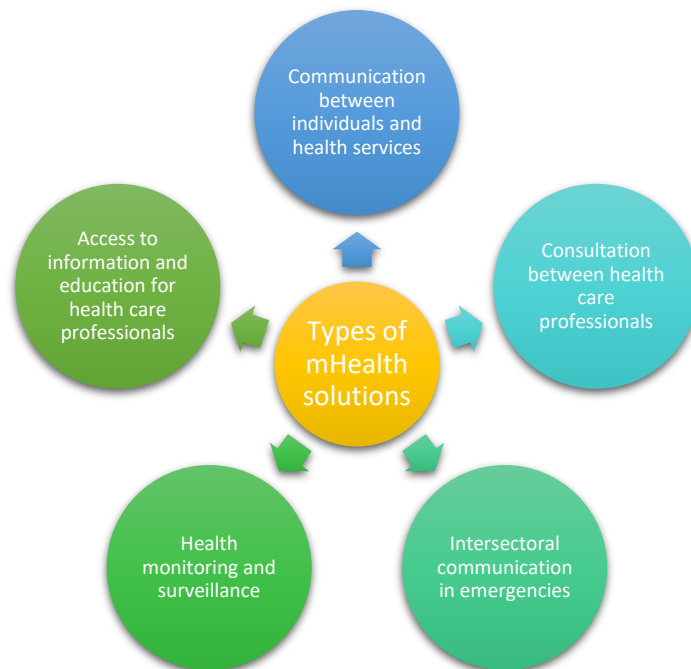
<sup>3</sup> Statista, mHealth - Statistics & Facts, 2020. Available at: <https://www.statista.com/statistics/387867/value-of-worldwide-digital-health-market-forecast-by-segment/>

## 2. What is mHealth?

MHealth or mobile health is defined by the WHO in its 2015 Global Observatory for eHealth report, revised in 2016, as the use of mobile devices, such as smartphones and devices for monitoring patients, for medical practice and public health. 83% of WHO country members have at least one mHealth initiative.<sup>4</sup>

In addition, mHealth solutions can be classified according to the structure of communication they establish as shown in Figure 1.

**Figure 1. Types of mHealth solutions by communication channel.**



Source: The CIU with data from WHO (2016).

According to the definition provided by the U.S. Department of Health and Human Services, telemedicine and mHealth are both part of a larger field of telehealth and “telemedicine” that has usually “been used to refer specifically to bilateral interactive health communications with clinicians on both ends of the exchange.”<sup>5</sup>

<sup>4</sup> Ibid.

<sup>5</sup> U.S. Department of Health and Human Services. “Report to Congress. E-health and Telemedicine”, 2016. Available at: <https://bit.ly/3aSDxAm>

The European Commission has a similar definition which additionally includes applications (apps), such as “lifestyle and wellbeing apps that may connect to medical devices or sensors as well as personal guidance systems, health information and medication reminders provided by SMS and telemedicine provided wirelessly.”<sup>6</sup>

Fortuin et al. (2016) describe that mHealth functions consist of voice calling, voice over internet protocol (VOIP), short message service (SMS) or text messaging, multimedia message service (MMS) and the Internet. The type of applications most often used in mobile health are:<sup>7</sup>

1. Consumer education and behavior change.
2. Sensors and point of care devices.
3. Registries and vital event tracking.
4. Data collection and reporting.
5. Electronic health records.
6. Electronic decision support.
7. Provider-provider communication.
8. Provider work planning and scheduling.
9. Provider training and education.
10. Human resource management.
11. Supply chain management.
12. Financial transactions and incentives.

The WHO claims that mHealth can contribute to achieving global health coverage, making it accessible to remote populations and communities with deficits in health services. At the same time, the WHO recognizes that it is inexpensive to provide these areas with mobile technology infrastructures.

### **2.1. LITERATURE REVIEW: EVIDENCE OF MHEALTH BENEFITS**

This section introduces some studies that demonstrate the direct benefits for patients of using mHealth platforms. With this in consideration we will be able to have

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<sup>6</sup> European Commission. (2014). Green Paper on mobile Health (“mHealth”). Available at: <https://bit.ly/3b7Svmf>

<sup>7</sup> Fortuin J, et al. “The impact of mHealth interventions on health systems: a systematic review protocol. Syst Rev” 2016 Nov 25;5(1):200. Available at: <https://bit.ly/3t6lJBo>

a perspective of the great and diverse potential individual and social benefits that the massification of these services among the population can generate.

Before addressing benefits from mHealth, it is relevant to describe general App economy benefits defined as:

...a collection of interlocking innovative ecosystems. Each ecosystem consists of a core company, which creates and maintains a platform and an app marketplace, plus small and large companies that produce apps and/or mobile devices for that platform...<sup>8</sup>

The App Economy reduces transaction costs for mobile software developers, which is particularly important for competition since it reduces entry barriers for small developers. Also, app stores are trustworthy platforms for users and developers to interact.<sup>9</sup>

App Economy's benefits translate into the mHealth sector by promoting a competitive and trustworthy segment. Mao et al. conducted a systematic review and meta-analysis to assess the impact of mHealth on countries with distinct levels of economic development. They searched PubMed, ResearchGate, Embase and Cochrane databases for articles published between January 2008 and June 2019. They discovered that mHealth intervention did not only play a significant role in improving clinical outcomes compared with conventional care, but also had a positive impact on countries with distinct levels of economic development.<sup>10</sup>

De Jongh et al. showed a positive impact has been demonstrated that text messaging interventions showed greater improvements in asthma pooled symptoms compared with the control group.<sup>11</sup>

Beatty et al. demonstrated that the exercise capacity in cardiac rehabilitation improved a 6-minute walk test from 524-637 meters in monitored exercise training

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<sup>8</sup> Goldsmith, B. (2014). "The Smartphone App Economy and App Ecosystems". In Goggin, G., & Hjorth, L. (Eds.). (2014), *The Routledge companion to mobile media* (pp. 171-181). London: Routledge.

<sup>9</sup> Deloitte (2020). "The App Economy in the United States". Available at: [https://www.ftc.gov/system/files/documents/public\\_comments/2018/08/ftc-2018-0048-d-0121-155299.pdf](https://www.ftc.gov/system/files/documents/public_comments/2018/08/ftc-2018-0048-d-0121-155299.pdf)

<sup>10</sup> Mao Y, et al. "Impact and efficacy of mobile health intervention in the management of diabetes and hypertension: a systematic review and meta-analysis". 2020. Available at: <https://bit.ly/3u6EvAy>

<sup>11</sup> de Jongh et al. "Mobile phone messaging for facilitating self-management of long-term illnesses. Cochrane Database" Syst Rev 2012. Available at: <https://bit.ly/3xCzYYw>



assisted by a mobile phone app. In an 8-week, nonrandomized clinical trial, there was 17.6% improvement in mobile versus 11.5% in control group.<sup>12</sup>

Conversely, Free et al. proved no statistically significant effects on chemotherapy-related toxicity symptoms when patients used a mobile phone app to report symptoms and receive self-care advice. But in the same research they demonstrated that text messages to maintain contact, monitor, and respond to medication issues in patients on antiretrovirals statistically significantly reduced human immunodeficiency virus (HIV) viral load by improving adherence.<sup>13</sup>

Agarwal et al. exposed studies that included data collection as a primary mHealth function and demonstrated that mobile phones effectively collect and report data, transfer patient-relevant information, and reduce the need for face-to-face communication.<sup>14</sup> Similarly, Gurol-Urganci et al. demonstrated a consistent improvement on medical attendance rates. Text message reminders improved the rate of attendance at health care appointments compared with no reminders.<sup>15</sup> Also, Aranda-Jan et al. proved a reduction in patient burden to transportation time and costs in African countries because of the implementation of mHealth projects.<sup>16</sup>

Whittaker et al. showed positive results of mobile phone-based cessation interventions increased smoking abstinence rates at 26 weeks, also six studies verified quitting biochemically at 6 months.<sup>17</sup>

Bacigalupo et al. presented evidence of short-term weight loss in overweight and obese adults with BMI of 25-39.9 using mHealth structured program. Also, they

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<sup>12</sup> Beatty et al. "Using mobile technology for cardiac rehabilitation: a review and framework for development and evaluation". J Am Heart Assoc 2013. Available at: <https://bit.ly/3aQgGVS>

<sup>13</sup> Free C et al. "The effectiveness of mobile-health technology-based health behavior change or disease management interventions for health care consumers: a systematic review". PLoS Med 2013. Available at: <https://bit.ly/3vsa484>

<sup>14</sup> Agarwal S, et al. "Evidence on feasibility and effective use of mHealth strategies by frontline health workers in developing countries: systematic review". Trop Med Int Health 2015. Available at: <https://bit.ly/3xvryT3>

<sup>15</sup> Gurol-Urganci I, et al. "Mobile phone messaging reminders for attendance at healthcare appointments." Cochrane Database Syst Rev 2013. Available at: <https://bit.ly/3aQPXIW>

<sup>16</sup> Aranda-Jan CB, et al. "Systematic review on what works, what does not work and why of implementation of mobile health (mHealth) projects in Africa." BMC Public Health 2014. Available at: <https://bit.ly/3xvrGlv>

<sup>17</sup> Whittaker R, et al. "Mobile phone-based interventions for smoking cessation." Cochrane Database Syst Rev 2016. Available at: <https://bit.ly/3u48OYs>

found that mobile phone personalized advice and motivation observed a significant improvement in percent of body fat lost.<sup>18</sup>

These studies show that there are many potentials benefits in the use and massification of mHealth programs across population. Among which are direct benefits to sick patients, improvement in treatment and attendance at medical appointments, modifications in user behavior such as losing weight or reducing tobacco consumption. In addition, the savings in medical social costs in reducing unnecessary visits to the doctor and costs related to treatment surveillance would be enormous, generating potential savings for public finances.

The National Centre for Technological Excellence in Health establishes that the main benefits for the Health System of introducing mHealth solutions are better use of resources; break down inequality barriers in terms of access to services; flexible and timely scientific and statistical analysis; improvement in public health management by health authorities; additional resources for teaching students, and establishment of medical support networks at the national level.<sup>19</sup>

The CIU has stated that apps related to health and wellbeing may be used in a variety of alternatives to improve healthcare for Mexicans, as well as to help health services to alleviate patient overload. Apps can represent a way to reduce costs to the healthcare systems, such as IMSS, since they can help to prevent and monitor diseases without the need of the use of their installations (reducing consults for non-communicable diseases for example). This is relevant as a cost-efficient solution since Mexico does not spend much on the healthcare sector -just 5.5% of the GDP, while this indicator goes to more than 10% in other OECD economies-.<sup>20</sup>

Nevertheless, is important to consider as an initial and necessary conditions are Internet access and the possession of a mobile or fixed device that allows the

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<sup>18</sup> Bacigalupo R, et al. "Interventions employing mobile technology for overweight and obesity: an early systematic review of randomized controlled trials." *Obes Rev* 2013. Available at: <https://bit.ly/3t055K5>

<sup>19</sup> National Centre for Technological Excellence in Health, *Ventajas y Beneficios de la Telemedicina*, Ministry of Health, 2018. Available at: <https://bit.ly/3oiO4CU>

<sup>20</sup> The CIU, *Wearables for an Inclusive Universal Healthcare System in Mexico*, 2021. Available at: <https://www.theciu.com/documentos-de-analisis/2021/2/17/wearables-para-un-sistema-de-salud-universal-inclusivo-en-mxico> Infomed, Red de Salud de Cuba. "Disponible aplicación desarrollada por Infomed sobre COVID-19", 2020. Available at: <https://bit.ly/3e3KY9P>

interaction and use of these medical applications so that the patient or user can satisfactorily use mHealth services.

## **2.2. SMARTPHONE AND APPS ADOPTION IN MEXICO**

Mobile devices may improve patient-provider communication, facilitating assistance in disease management. It may increase the likelihood of delivering health interventions to hard-to-reach populations. Whittaker et al. listed advantages of using mobile interventions: convenience, ease, cost-effectiveness, scalability, personalization, and the possibility to send time-sensitive messages at any moment.<sup>21</sup>

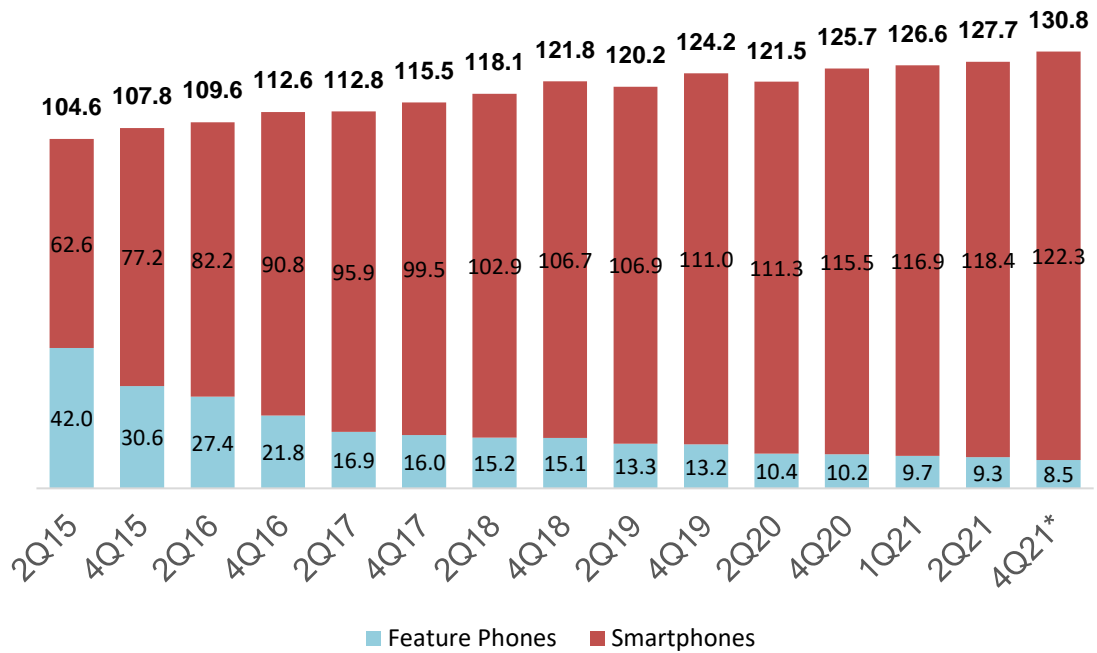
The smartphone market has been one of the most dynamic in recent years in terms of adoption, technological renewal, and configuration of its competitive ecosystem. In Mexico, during the last five years the number of smartphones increased by 85% between 2015 and 2020. This evolution can be seen in Figure 2, where the red bars represent the evolution of the number of mobile lines associated with smartphones and the blue bars, the evolution of those associated with a featurephones.

At the second quarter of 2021, a total of 127.7 million smartphones were counted among the population, an annual growth of 5.1% despite the negative effect on the income of individuals caused by the economic crisis of COVID-19. This suggests the services provided by these devices are highly valued by individuals.

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<sup>21</sup> Ibid. Whittaker R, et al., 2016.

**Figure 2. Total Smartphones in Mexico (2015-2021\*)**  
(Millions)

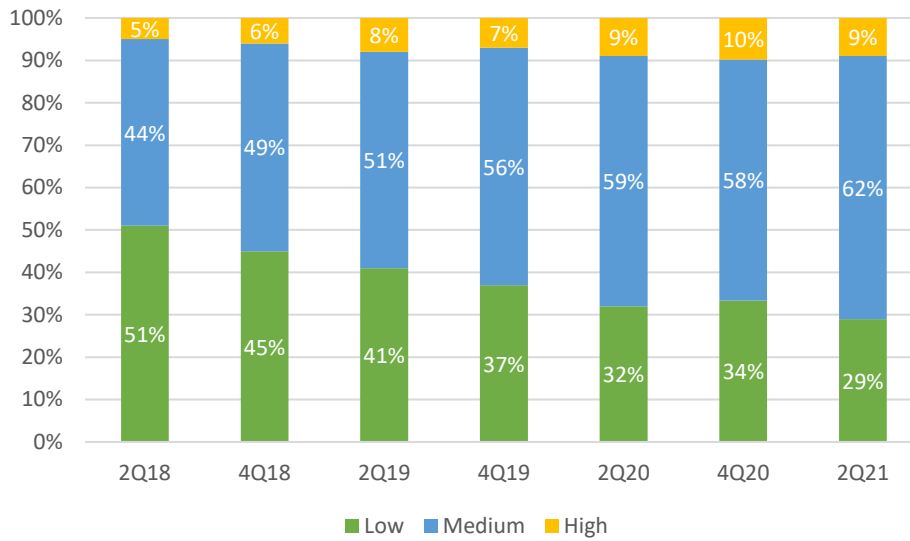


Source: The Competitive Intelligence Unit, \*forecast.

In recent years, the configuration in consumer preferences, based on the offer of equipment developments of all ranges of smartphones has been modified through the increasing sophistication of preferences and intensification of user use, increasing interest and value of having devices with better technological capabilities. This was significantly boosted during the pandemic where individuals required a device with sufficient capabilities to conduct remote activities such as teleworking or tele-education.

Therefore, during 2020 there was an increase in the proportion of users with high-end smartphones, accounting for 9%, an increase of +2 pp. compared to 2019. While the mid-range tenure from 2019 to 2021 increased 11 percentage points, going from 51% to 62%. This information can be seen in Figure 3.

**Figure 3. Smartphones Distribution by Range in Mexico (2018-2021)**



Source: The Competitive Intelligence Unit.

The medium and high ranges jointly cover 71% of the total market, this confirms the budgetary effort of consumers, for having equipment with greater technological capabilities. In this way, the user can conduct more activities through their smartphone such as: video calls, activities related to electronic commerce, use of health applications, education, among others.

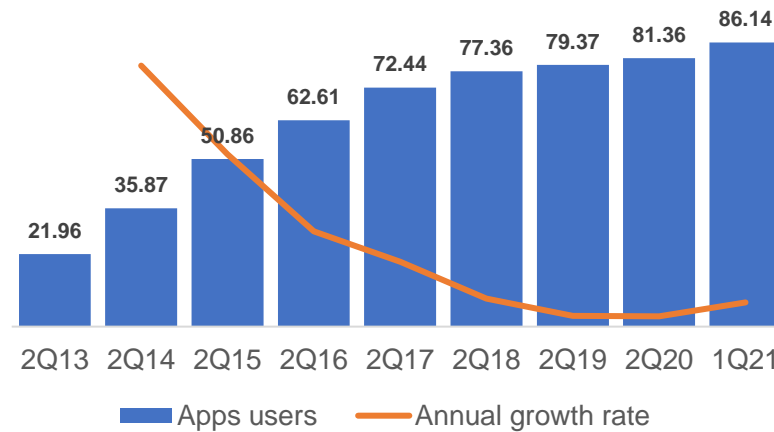
The competitive structure of the smartphone market has been dynamic during the pandemic, there has been atomization and growing competition for the number of manufacturers competing for the market.

The massification in the adoption of Smartphones is already a reality in Mexico. The competitive dynamics and the growing preference for this equipment has led to changes in the market weighting of the different equipment manufacturers and of the different technological offers.

Today an observable characteristic in this market is the incessant need for technological renewal and the launch of new equipment of all ranges to serve a market with growing and diverse needs.

According to The Competitive Intelligence Unit (The CIU), the penetration of applications (apps) users is 76.3% of Mexicans over 5 years of age, equivalent to 86.7 million users. They are mobile application users that prefer devices like smartphones (97.1%), the tablets (13.7%) and the PC or Laptop (5.6%) for the use of these applications. Figure 4 shows that despite the slowdown in the rate of increase of apps users during the last six years in Mexico, in the period 2020-2021 there was an important increase (5.9%) that most that doubled the rate from the immediate period before.

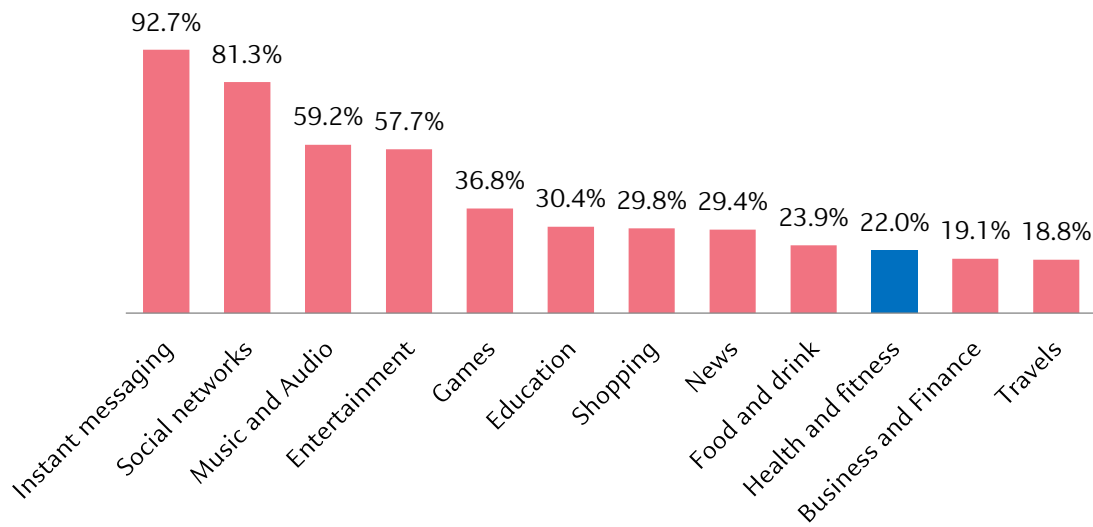
**Figure 4. Apps users (2013-2021).**  
**(Millions)**



Source: The Competitive Intelligence Unit.

When looking at what kind of apps users prefer in Mexico to The CIU found that most of it are instant messaging apps (92.7%), social networks (81.3%), and music and audio (59.2%). Nevertheless, an important share of users (22%) downloads apps related to health and fitness. The distribution of apps by category can be seen in Figure 5.

**Figure 4. Apps distribution by category.**



Source: The Competitive Intelligence Unit.

It is important to note that for apps to deliver efficient health services and reach more users, their needs, age, and education level must be considered in its development and implementation. Usage might improve with user-centered design, engagement strategies, and constant feedback from users.

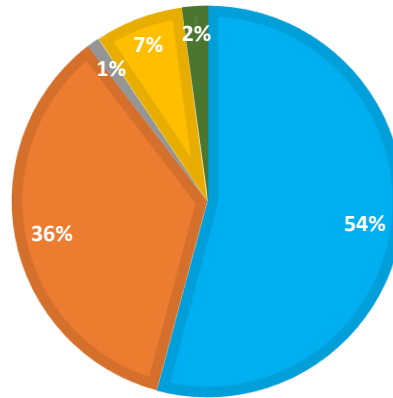
### 3. Apps for patients

#### 3.1. CATALOG

We registered a sample of ninety-six apps related to healthcare, wellbeing and/or fitness in the Play Store and App Store available in Mexico and found that: in average, the score received is 4.2/5; most applications stand in the range of ten million downloads and belong to the category "Fitness". In Figure 6 it is shown five categories of the apps we mapped in the two sites: Fitness, Health Services, Health Information, Drugstores, and Covid-related. The categories of Fitness and Health Services gather 90% of the market while the least are apps specifically designed to track the spread of Covid-19.

**Figure 6. Distribution of apps related to healthcare by category.**

■ Fitness ■ Health Services ■ COVID-19 Tracking ■ Drugstores ■ Informative



Source: The CIU with data from App Store (2021) and Play Store (2021).

This mapping of apps also revealed that 86% of the available apps come from the private initiative while 14% are administrated by a public institution. Despite the reduced participation of public administrated apps one of the most successful cases in Mexico for its wider spread is IMSS Digital, the app from the Instituto Mexicano del Seguro Social (IMSS).

### 3.2. IMSS DIGITAL

IMSS Digital is the mobile application of IMSS to offer and facilitate several services to IMSS total beneficiaries, which reach the impressive amount of more than 48 million people in Mexico (almost 40% of total population).<sup>22</sup> Because of the extension of IMSS, its efforts to offer services digitally reveals the strengths and opportunities for initiatives of its kind in the country. The latest data reveals that there are 8.6 million downloads of the app, close to 17% of IMSS total users, with an annual increase of 41% in the period 2019-2020.<sup>23</sup>

IMSS Digital was created in 2017 and since then has provided more than a 1,000 million procedures and services saving time and travel expenses to users and reducing

<sup>22</sup> INEGI, Census 2020, Population with affiliation to health services by federal entity according to institution, 2020. Available at:

[https://www.inegi.org.mx/app/tabulados/interactivos/?pxq=Derechohabiencia\\_Derechohabiencia\\_02\\_822ebcc5-ef41-40c1-9901-22e397025c64](https://www.inegi.org.mx/app/tabulados/interactivos/?pxq=Derechohabiencia_Derechohabiencia_02_822ebcc5-ef41-40c1-9901-22e397025c64)

<sup>23</sup> IMSS, Work Report and Activity Program 2019-2020, 2020.p.301. Available at: <http://www.imss.gob.mx/sites/all/statics/pdf/informes/2020/ILPA-2019-2020.pdf>



the administrative burden of IMSS's facilities.<sup>24</sup> According to IMSS its income in the period January-June 2020 was 7,000 million pesos bigger than expected in part due to the simplification and digitalization of procedures of the use of IMSS Digital.<sup>25</sup>

This app was recognized by the International Social Security Association (ISSA), one of the most important international organisms of social security in the world, with Special Mention because of its contribution to innovative solutions to develop administrative tasks with efficiency and efficacy.<sup>26</sup>

There are nine procedures and six specific services to attend Covid contingency in IMSS Digital. Historic data show that since the creation of IMSS Digital in 2017 the digital procedures augmented 5.6 times (equivalent to an increase in 420.3 million procedures).<sup>27</sup> The list can be consulted in table 1.

**Table 1. Full list of procedures and services in IMSS Digital.**

Ordinary procedures	Covid related services
<b>1. Obtain or consult the Social Security Number (NSS).</b>	1. Location of respiratory attention modules.
<b>2. Healthcare clinic assignment for IMSS beneficiaries.</b>	2. Questionnaire to detect potential COVID-19 infection and COVID-19 leave of absence
<b>3. Discharge and change of health center.</b>	3. Location of hospitals and clinics for COVID-19 patients
<b>4. Location of healthcare facilities (IMSS facilities and clinics by zip code).</b>	4. COVID-19 Complications Calculator.
<b>5. Consultation of validity of rights.</b>	5. Find out about your family member: mechanism to inform about the health situation of

<sup>24</sup> Ibid.p.23.

<sup>25</sup> Ibid.p.258.

<sup>26</sup> IMSS, IMSS Digital receives international recognition, 2017.Available at: <http://www.imss.gob.mx/prensa/archivo/201711/374>

<sup>27</sup> Ibid, IMSS, 2020.p.300.

	relatives to avoid face to face exchange of information.
<b>6. Medical appointment.</b>	
<b>7 CHKT Online: questionnaire to detect diabetes or hypertension risks.</b>	
<b>8. Heart attack code: locate the nearest health center with equipment to treat heart attacks</b>	
<b>9. Parents' leave for medical care of children or adolescents with cancer</b>	

Source: The CIU with data from IMSS (2021).

It stands out that procedures such as “Heart attack code” that offers the list of medical units closer to the user relies on the usage of several technologies such as Global Positioning System (GPS). IMSS reveals that one of its four most consulted services is “Medical Appointment,” which reduces unnecessary overcrowding of its installations.<sup>28</sup>

One identified area of opportunity is the interoperability with wearables like smartwatches to autofill and give more accurate data that by now is manually filled in the several questionnaires of IMSS Digital like CHKT online, that identify risks of hypertension and diabetes mellitus, and Questionnaire and COVID-19 Permit, that identifies symptoms related to COVID-19.

In a working paper developed by The CIU and the Autonomous Institute of Technology of Mexico (ITAM) it is suggested that the inclusion of wearables in prevention of Non-Communicable Diseases strategies can relieve the finances of IMSS and other health institutions since these are the most common ailments in Mexican population.<sup>29</sup>

<sup>28</sup> IMSS, IMSS Digital: Most consulted services, 2021. Available at: <http://www.imss.gob.mx/imssdigital>

<sup>29</sup> The CIU, Wearables for an Inclusive Universal Healthcare System in Mexico, 2021. Available at: <https://www.theciu.com/documentos-de-analisis/2021/2/17/wearables-para-un-sistema-de-salud-universal-inclusivo-en-mxico>

## 4. Apps for clinicians

In this section the analysis of mHealth is expanded to cover those applications and ICT based solutions that help clinicians on their work.

According to the WHO the most widespread solution based on ICT for health is teleradiology (reaching up to 77% of WHO members). Telepathology, remote patient monitoring and tele dermatology are also popular.<sup>30</sup>

The possibility video conferencing with doctors and/or via IoT-connected medical devices have exploded the demand of this kind of services during the pandemic because they are a risk-free way to continue with treatment. An example is the increase of telemedicine visits in the U.S. going from 0.15% of the total to 13% in just one year (before the pandemic).<sup>31</sup> Another example is the previously mentioned case of increased use of IMSS Digital.

Here are some examples of mobile app solutions that assist clinicians on their labor to deliver health:

### **Eye Examination solution**

This smartphone-based system for comprehensive eye testing is supported by with a retina adapter added to the smartphone camera that allows users to deliver eyesight tests in an affordable and effortless way. The analysis of the retina allows clinicians to detect and give proper treatment for cataracts. It also detects features of glaucoma, hypertensive eye disease, macular degeneration, diabetic and malarial retinopathy, and signs of nerve disease.

This solution contributes to prevention and prompt care campaigns that, according to WHO, can eliminate 80% of world's blindness.<sup>32</sup>

### **Advice on patients' treatment**

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<sup>30</sup> Global Observatory of eHealth, "Global diffusion of eHealth: Making universal health coverage achievable", WHO, 2016.p.10. Available at: <https://bit.ly/3xBGsH5>

<sup>31</sup> During the pandemic, this percentage rose to 95% in some specialties. See: Kurt R. Herzer, et al. Ensuring Quality in the Era of Virtual Care. JAMA 2021;325(5):429-430. Available at: [https://jamanetwork.com/journals/jama/article-abstract/2775722#\\_blank](https://jamanetwork.com/journals/jama/article-abstract/2775722#_blank)

<sup>32</sup> Ibid. WHO, 2016. p.72.

Some apps can create networks of health workers to give and receive advice on patients' treatment plans and refer patients to specialist services. Such solutions allow primary healthcare workers to gather information about a patient, and then send referrals directly to medical specialists.<sup>33</sup> This is especially useful for underserved communities and its people who have a great financial barrier just to get a diagnosis because of the costs to transport to different medical centers.

Solutions like those describe above works for all medical specialties and through high quality images and description, primary health workers share information to get a better diagnosis for their patients via phone call or chat with specialists.<sup>34</sup>

### **Health workers performance**

Some mobile solutions offer multimedia enabled job-aids- with the use of audio-visual self-learning and counselling tools- and on-demand training for health workers whose labor can reduce maternal, neonatal, child mortality and total fertility rate in the communities they work. For example, mSehat is a solution that can be used in tablets and smartphones and, according to WHO, in 2016 was the largest public-private partnership mHealth implementation in the world (serving up to 11.15 million users).<sup>35</sup>

Another interesting use of mHealth is eLearning for medical students and in-service training which is used in 84% of WHO members.<sup>36</sup> The opportunity to expand access to knowledge on health is substantial to meet the target 3.c of UN Sustainable Development Goals agenda: "Substantially increase health financing and the recruitment, development, training and retention of the health workforce in developing countries, especially in least developed countries and small island developing States".<sup>37</sup>

A study of Minsait reveals that Mexico has the smaller ratio of clinicians per 1,000 inhabitants among six Hispanic countries of Latin America (Argentina, Chile, Colombia, Mexico, Peru, and Uruguay).<sup>38</sup> This information does not reveal though the gaps

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<sup>33</sup> The Compass for SBC, "VulaMobile", 2021. Available at: <https://www.thecompassforsbc.org/project-examples/vulamobile>

<sup>34</sup> VulaMobile, "Vula's awards over the years", 2021. Available at: <https://www.vulamobile.com/news-media/gm3qz8gcb3yw4v6rpxi1i0usjmgd1w>

<sup>35</sup> Ibid. WHO, 2016, p.53.

<sup>36</sup> Ibidem. WHO, 2016.

<sup>37</sup> United Nations, Goal 3, 2021. Available at: <https://sdgs.un.org/goals/goal3>

<sup>38</sup> Minsait, "Libro Blanco de Interoperabilidad en Salud, América Latina", 2021. Available at: <https://www.minsait.com/es/actualidad/insights/libro-blanco-de-interoperabilidad-en-salud>

between medical specialists and primary care clinicians. It can be inferred that in addition to a gap in doctors there is also a gap in specialized knowledge therefore, eLearning stands out as a valuable tool to improve healthcare provision in the country.

An article of Jorge Ruiz et al. studies the impact of eLearning in medical education and observe that:

in diverse medical education contexts, e-learning is at least as effective as traditional instructor-led methods such as lectures... Innovations in e-learning technologies point toward a revolution in education, allowing learning to be individualized (adaptive learning), enhancing learners' interactions with others (collaborative learning), and transforming the role of the teacher.<sup>39</sup>

In a working paper title "Pocket Classroom" The CIU pointed that in Mexico Artificial Intelligence (AI), Virtual Reality (VR) and Augmented Reality (AR) are tools that increase the educational potential of video games since they make the teaching and learning experience efficient. They also affirm that the contingency derived from COVID-19 has promoted public policy efforts aimed at distance education nevertheless it still lacks a mobile component -essential part of eLearning and mHealth-.<sup>40</sup>

## 5. Covid-19

The current pandemic has revealed how m-health, via mobile apps, can serve expanding campaigns of awareness. Several examples among different countries reveal how apps can be used to inform users about COVID-19 risks, symptoms, and healthcare institutions to treat the disease. Although this does not pretend to be a full list of all COVID-19 related apps available in the world it gathers representative examples and can be complemented with the rest of examples presented in the Appendix section.

### 5.1. MEXICAN EXPERIENCE WITH APPS FOR COVID-19

The following is a list of examples of apps developed from local governments in Mexico to cope with the COVID-19 sanitarian crisis. It stands out that they work as a

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<sup>39</sup> Jorge G. Ruiz, MD, Michael J. Mintzer, MD, and Rossane M. Leipzig, MD, PhD, "The Impact of E-Learning in Medical Education", *Academic Medicine*, Vol. 81, No. 3 / March 2006. Available at: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1075.338&rep=rep1&type=pdf>

<sup>40</sup> The CIU, *Pocket Classroom*, 2020. Available at: <https://www.theciu.com/documentos-de-analisis/2020/6/8/pocket-classroom-desarrollo-de-videojuegos-mviles-para-la-educacin>

complementary tool of health policy giving users information to prevent the spread of the virus as well as to, in some cases, present a questionnaire to self-test if they are sick or not based on common symptoms. Additionally, the case of the app developed by the government of Sonora goes a step further by connecting doctors and patients to treat the symptoms of the disease in a real time platform.

### **Nationwide**

Available to all individuals at a national level, a self-diagnosis application was developed that, through a questionnaire, allows its users to obtain recommendations. It uses geolocation services to provide users with the closest available health centers. It offers information, press conferences and releases from the Ministry of Health.<sup>41</sup>

### **Puebla (potential exposure)**

“Alerta COVID Puebla” is a notification mechanism (mobile app) of potential exposure to the COVID-19 virus. People will be notified when detected they were in touch with a person who tested positive for COVID-19, without revealing the identity of the infected person.<sup>42</sup>

### **Puebla (self-assessment)**

Local initiative application of the Government of Puebla allows people to conduct self-assessments to determine if they are at risk of contracting the disease. This can be done through the web, a specific app or even WhatsApp. There, users can find questionnaires with general data and symptoms that can determine suspicious cases.<sup>43</sup>

### **Coahuila**

The local government introduced a mobile application that informs whether the user was in contact with a positive case of COVID-19. This software works through Bluetooth and can be installed with the help of a QR code, the information that it will be shared is completely voluntary and users’ sensitive data is not revealed.<sup>44</sup>

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<sup>41</sup> App Store, Secretaría de Salud. “COVID-19MX”, 2021. Available at: <https://apple.co/3u5TMS9>

<sup>42</sup> Gobierno de Puebla (2021). “Boletín 353/2021: Gobierno estatal pone en marcha “Alerta COVID Puebla”, una aplicación para notificar posible exposición al virus”. Available at: <https://bit.ly/3kKRtKt>

<sup>43</sup> Laboratorio de Innovación e Inteligencia Artificial. “Aplicaciones móviles y COVID-19”, 2020. Available at: <https://bit.ly/3tdCLOp>

<sup>44</sup> Milenio (2021). “Coahuila presenta app que te dice si estuviste cerca de alguien con covid”. Available at: <https://bit.ly/3CpRVLo>

Both the Coahuila and Puebla exposure notifications systems are the same. this solution was jointly developed by Google and Apple as a measure to help governments to avoid the spread of COVID-19.

### **Tamaulipas**

The Government of Tamaulipas developed a technological tool, COVID-19 Tam, to communicate active COVID-19 cases, as well as providing information on the total number of cases in the state. It can obtain a breakdown of total active cases, recovered and fatal. To work, this tool accesses geolocation service.<sup>45</sup>

### **Jalisco**

The Ministry of Finance of the Government of Jalisco launched Plan Jalisco Covid-19, which allows the verification of users that had contact with individuals suffering from the disease or exposed to conditions or places that could be in danger of contracting the virus.

The application allows geolocation to establish proper contact and follow-up of the cases of suspected. It also provides information on symptoms and prevention measures to help prevent its spread.<sup>46</sup>

### **Nuevo León**

The state of Nuevo León developed an app that includes official information about COVID-19. It allows easy access to newsletters, alerts, updates on cases and geolocation. To this end, it offers a questionnaire to perform a self-test.<sup>47</sup>

### **Sonora**

The Ministry of Health in Sonora developed an application to prevent, detect and treat potential cases in real time. This is done through specialist, available online, and can be consulted using telecommunications devices.<sup>48</sup>

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<sup>45</sup> Laboratorio de Innovación e Inteligencia Artificial. “Aplicaciones móviles y COVID-19”, 2020. Available at: <https://bit.ly/3e6i3SB>

<sup>46</sup> Ídem

<sup>47</sup> Gobierno del Estado de Nuevo León. “Descarga la App del Gobierno de NL sobre COVID-19”, n.d. Available at: <https://bit.ly/3e413w7>

<sup>48</sup> El Heraldo de México. “Presenta Salud Sonora app para detectar y prevenir Covid-19”, 2020. Available at: <https://bit.ly/3vzFtFR>

## 5.2. INTERNATIONAL EXPERIENCE

### Exposure Notifications: United Kingdom and Germany

Several countries, including United Kingdom (2020) and Germany (2020) have implemented the exposure notifications system developed by Google and Apple which enables the use of Bluetooth technology on mobile devices for governments and health reduce the spread of COVID-19 through contact tracing, emphasizing user privacy and security.<sup>49</sup>

The notification app in Germany (Corona-Warn-App) accounted for 34.4 million downloads<sup>50</sup> by September 2021, this accounts for 41% of the population<sup>51</sup>, while in United Kingdom the number of downloads of the app (NHS COVID app) reaches 27 million by July 2021<sup>52</sup>, i.e., almost 40% of the population in that country.<sup>53</sup>

### South Korea

A platform called Korea Spatial Information & Community has a map service that helps identifying the detection of COVID-19. It can determine the situation of patients and places of diagnosis and care, using geolocation of devices.<sup>54</sup>

In turn, a technology developed, Self-Quarantine Safety Protection, allows monitoring citizens in quarantine. Through GPS, it sends alerts, to the corresponding authority, of those who violate isolation measures.<sup>55</sup> This app has been recognized as an example of significant policies.

### India

Developed in Greater Mumbai, BMC Combat COVID-1921, uses geolocation services to track health progress and contain the spread of the virus.<sup>56</sup>

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<sup>49</sup> Apple (2020). "Exposure Notifications FAQ". Available at: <https://bit.ly/3cCHfP7>

<sup>50</sup> Statista (2021). "Anzahl der Downloads der Corona-Warn-App über den Apple App Store und den Google Play Store in Deutschland von Juni 2020 bis September 2021". Available at: <https://bit.ly/3qLIXqG>

<sup>51</sup> World Bank (2021). "Population total-Germany 2020". Available at: <https://bit.ly/3qN9HG8>

<sup>52</sup> Statista (2021). "Cumulative downloads of the NHS COVID-19 app in England and Wales as of July 2021". Available at: <https://bit.ly/3HzEOe6>

<sup>53</sup> World Bank (2021). "Population Total- United Kingdom 2020". Available at: <https://bit.ly/3oKHtck>

<sup>54</sup> National Spatial Information Portal. "Introduction to Spatial Information Portal", 2021. Available at: <https://bit.ly/2S4gLib>

<sup>55</sup> MIT Technology Review. "Coronavirus Smartphone App", 2021. Available at: <https://bit.ly/3xCzYaY>

<sup>56</sup> App Store, BMC Combat Covid-19. "Municipal Corporation of Greater Mumbai (MCGM)", 2021. Available at: <https://apple.co/33eeofj>



In terms of downloads, Aarogya Setu, leads the market. In April 2020, it was inside the top 10 most downloaded apps in the world.<sup>57</sup> Nevertheless, this app received a lot of criticism, for things such as not being voluntary for millions of users, not limiting the use of the data collected, or collecting more data than it needs to.

### **France**

COVIDOM is an application designed for patients infected (or suspected) who have passed through hospitals in Paris, but do not require hospitalization. Patients receive a medical questionnaire, and in case of acute symptoms, a healthcare team is notified. This allows remote monitoring of patients without overloading health facilities. This is done by a doctor who creates the patient's profile on the platform, and patients must answer the questionnaire every day.<sup>58</sup>

### **Germany**

As of July 24, 2020, the German Corona-Warn app had been downloaded 16.2 million times, about 20% of the population. However, it was revealed that the application did not work properly for millions of potential users. Some Android operating systems blocked the application from running in the background.<sup>59</sup>

All these examples reveal how mobile apps have attended specific interests and needs of governments cross the world to tackle the current pandemic. It stands out how many uses the services of GPS to determine who is violating isolation measures or who had contact with a sick person. It is also worth mentioning all the challenges this apps have faced during their implementation like being able to keep running in the background or the restrictions of use of the information it gathers.

In the following section the specific challenges to adopt mHealth are introduced along with recommendations to overcome it.

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<sup>57</sup> Deutsche Welle. "Aplicaciones de rastreo de COVID-19: lejos del éxito global", 2020. Available at: <https://bit.ly/3eGhcag>

<sup>58</sup> Republique Francaise. "Application Covidom: un télésuivi des patients porteurs ou suspectés de Covid-19", 2020. Available at: <https://bit.ly/3xDkgRp>

<sup>59</sup> Deutsche Welle. "Aplicaciones de rastreo de COVID-19: lejos del éxito global", 2021. Available at: <https://bit.ly/3u4CvZD>

## 6. Challenges to m-health adoption

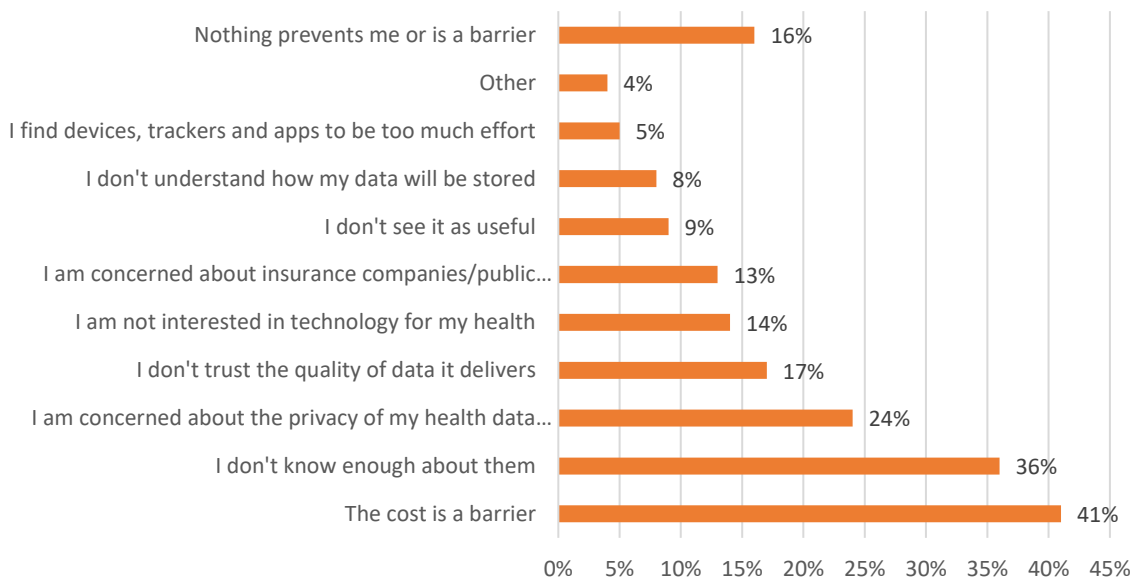
When well-articulated, eHealth strategies should enable the interoperability needed to support people-centered health services for everyone, and the move from disease silos to resilient health systems which can deliver universal health care<sup>60</sup>

### 6.1. COST, IGNORANCE AND LACK OF CONFIDENCE

In 2018, Ipsos run a survey in Mexico to 500 respondents asking: "What, if anything, prevents you from using/owning a connected device or tool for your health?", multiple answers were possible, and the results are presented in Figure 7. As it can be seen, the most answered reason not to use a m-health device is the cost, followed by lack of knowledge about this kind of devices and, in third place, the concern towards privacy and data access.<sup>61</sup>

These barriers can be simplified by saying that in Mexico people do not use devices or apps to track their health because of cost, ignorance, and lack of confidence.

**Figure 7. Main barriers to the usage of mHealth devices among adults in Mexico as of 2018**



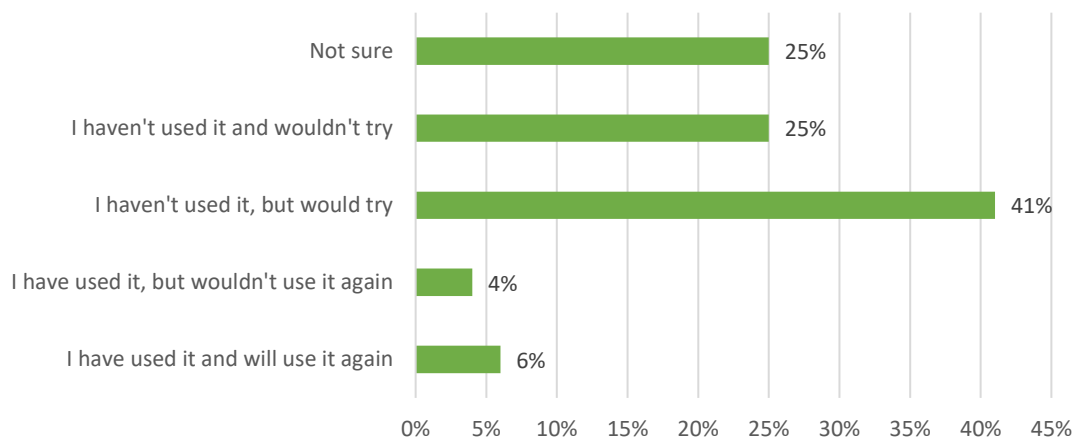
Source: The CIU with data from Ipsos (2018)

<sup>60</sup> Global Observatory of eHealth, "Global diffusion of eHealth: Making universal health coverage achievable", WHO, 2016. Available at: <https://bit.ly/3xBGsH5>

<sup>61</sup> Ipsos, Global views on healthcare, Ipsos, 2018.p.77.

Although a great percentage of the respondents revealed they did not know enough of this devices or apps, a greater percentage (41%) showed willingness to try them as it can be seen in Figure 8. Adding up the percentage of previous users of telemedicine that would be willing to keep using it that results in almost half of the population (47%) that is willing to use apps that provide this service.<sup>62</sup>

**Figure 8. Opinions on the usage of telemedicine among adults in Mexico as of 2018**



Source: The CIU with data from Ipsos (2018)

This information is coherent with the global growth of mHealth market presented in the introduction section. It is important to mention that despite one the perceived barrier to adoption of mHealth is costs, the most widespread app in the Mexican market is IMSS Digital, a governmental and free app. The gap in years from the survey on access barriers and the latest data on IMSS Digital appropriation suggests that as more users interact with free governmental apps and beneficiate from it, more users will value the services delivered in mHealth and will be willing to pay for them, eliminating the barrier of costs.

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<sup>62</sup> Ibid. p.73.

## 6.2. LEGISLATION AND PROMOTION OF INNOVATION

From an institutional perspective the challenges to adopt eHealth solutions in form of wearables has been previously addressed by The CIU. They identified two main challenges: interoperability, and connectivity.

Interoperability is the framework that allows healthcare providers to share and consult medical information of patients regardless of where it was generated. The objective is to avoid doubled diagnosis and to obtain a comprehensive medical record of the patient to observe the evolution of its health in time and the diverse opinions of clinicians that had attend her.

To guarantee interoperability within the medical healthcare system overcoming fragmentation in diverse public and private healthcare institutions becomes essential. Protection and delimitations of use of healthcare data is one of the current concerns in some healthcare apps as seen in previous sections, therefore it is important to guarantee the protection of patient data and define how healthcare information that comes from a mobile device such as a smartphone, tablet or smartwatch would be collected, used, shared and storage.

Efficient regulation of medical devices should guarantee access to high quality and effective products; in addition, it ensures benefits to public health and safety of patients, health workers and communities. As such, technological advances confirm the need to update regulations, adapting them to a market that is evolving day by day, offering new alternatives for making diagnoses and treatments faster and precisely.<sup>63</sup>

The current NOM for Electronic Registry Health Information Systems (NOM-024-SSA3-2012) does not consider health information from mobile devices such as smartphones or smartwatches as medical information to be used for health institutions. There is an initiative for a Digital Health Act which intends to modify this.<sup>64</sup>

Also, a NOM draft known as PROY-NOM-241-SSA1-2018 (not yet approved) proposed, among other aspects, a definition of software as a medical device as one “that does not require hardware to fulfill the intended medical purpose; it is capable of

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<sup>63</sup> Ibid. The CIU, 2020.

<sup>64</sup> Cámara de Diputados, “Iniciativa Que Expide La Ley De Salud Digital, A Cargo Del Diputado Éctor Jaime Ramírez Barba, Del Grupo Parlamentario Del Pan”, 2021. Available at: [http://sil.gobernacion.gob.mx/Archivos/Documentos/2021/03/asun\\_4161366\\_20210324\\_1616609171.pdf](http://sil.gobernacion.gob.mx/Archivos/Documentos/2021/03/asun_4161366_20210324_1616609171.pdf)

running on general computing platforms and can be used alone or in combination with other products”.<sup>65</sup>.

Regulation attempts like PROY-NOM-241-SSA1-2018 seem to be more appropriate, since some software (including mobile applications) could be considered as medical software, nevertheless great care should be taken so this sort of regulation attempts does not exceed its scope and define devices (such as smartphones or wearables) as medical devices as well, impacting their adoption.

The initiative for Digital Health Act covers subjects such as telemedicine, eLearning in medicine, and electronic medical record. It tries to respond to a lack of proper framework for the implementation of healthcare policies based on ICT. For example:

- Unclear regulation for digital healthcare provision.
- Unclear regulation regarding Electronic Medical Record
- Inexistent regulatory framework for digital health services providers.

Despite the Ministry of Health has a specialized organism in charge of eHealth- the National Center of Technological Excellence in Health (CENETEC, for its acronym in Spanish)-, its activity limits to recommendations and guidelines that are not mandatory and so have not clarified a regulatory framework for eHealth in Mexico.

The goal of the initiative is to give CENETEC the power to establish requirements, promote continuing learning and oversee the activity of eHealth providers. In addition, it would be capable of design, implement and sanction violations to the Digital Health Law. It will oversee promoting and defining quality standards for telemedicine and interoperability systems of healthcare information, looking to guarantee interoperability.

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<sup>65</sup> Diario Oficial de la Federación, “Official Mexican Standard Draft PROY NOM 241 SSA1, Buenas prácticas de fabricación de dispositivos médicos.” México, 6 de junio de 2019. Available at: [https://www.dof.gob.mx/nota\\_detalle.php?codigo=5562796&fecha=14/06/2019](https://www.dof.gob.mx/nota_detalle.php?codigo=5562796&fecha=14/06/2019)

### 6.3. ICT DEVELOPMENT

One of the minimum requirements for telemedicine services, according to the initiative, is that healthcare providers must have a rapid and stable broadband connection to internet. Nevertheless, connectivity is a great challenge per se.

The Social Intelligence Unit has denounced a regional gap of connectivity in the country where states in the South have the less development of ICT.<sup>66</sup> And also have revealed a positive correlation between ICT development and life expectancy in states of Mexico.<sup>67</sup> In addition, the Federal Institute of Telecommunications generated a study where demonstrated a nation-level causal relation between ICT use- defined as access to Wi-Fi- and life expectancy.<sup>68</sup>

Albeit the link between ICT development and health development has been reassured, there efforts of policies such as National Digital Strategy to gather these two phenomena in a single package has felt short.

The CIU conducted a feasibility analysis of Electronic Medical Record in Mexico and showed that less than a half (43.71%) of health services and social assistance providers had computers and access to internet, 49.36% and 43.71% respectively.<sup>69</sup>

More importantly, the users who can benefit more from mHealth programs are those in underserved communities where healthcare services do not reach them. According to the Organization for Economic Cooperation and Development (OECD), in 2019 the coverage of a basic set of healthcare services in Mexico was 89.3%, the lowest among its members.<sup>70</sup>

The Census 2020 held by the National Institute of Statistics and Geography (INEGI) reveals that at national level only 38% of households have a computer and 52%

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<sup>66</sup> The Social Intelligence Unit. "Índice de Desarrollo TIC para México y Brecha de Desarrollo", 2020. Available at: <https://mailchi.mp/theciu.com/distro001-869o8>

<sup>67</sup> The Social Intelligence Unit. "Salud y Desarrollo TIC: una relación de Complementariedad", 2021.

<sup>68</sup> IFT, "El Uso De Las Tic Genera Un Impacto Positivo Directo En El Ingreso Y La Salud De Los Mexicanos", 2020. Available at: <http://www.ift.org.mx/estadisticas/analisis-del-impacto-de-las-tic-en-el-desarrollo-social-de-mexico>.

<sup>69</sup> The CIU, Electronic Medical Record, 2021. Available at: <https://bit.ly/3cnyKax>

<sup>70</sup> OECD. "Health at a Glance 2019". México, 2019. Available at: <http://www.oecd.org/mexico/health-at-a-glance-mexico-ES.pdf>

have access to the internet.<sup>71</sup> This information reveals how the gap of connectivity is both from providers and patients.

## 7. Final Remarks

Mobile Health or mHealth is a tool that expands healthcare services in an effective and reduced cost, reaching millions of people in the world. It is recognized as a solution to reach communities that other way finds it impossible to receive proper healthcare. The mHealth scope is unlimited, being capable to attend all specialties of medicine and to adapt to languages and cultural contexts.

mHealth is also extremely helpful to healthcare providers because it allows them to create collaborative networks and assist them with procedures via virtual counselling. Recognizing there is not only a need for more doctors but for specialized treatments, eLearning through apps can improve healthcare provision in Mexico.

Analyzing the market of smartphones and apps there is clearly a boom for both goods. In Mexico there is a non-stop increase of smartphone adoption since 2015 and the vast offer of apps in the market attracts diverse types of users. Half of the population (47%) is willing to use apps that provide telemedicine.

As the market demands more of this kind of services the most important challenges for mHealth expansion are interoperability and connectivity. Challenges are:

- There is not a specific regulation for digital healthcare provision.
- Unclear regulation regarding Electronic Medical Record.
- Inexistent regulatory framework for digital health services providers.

To our knowledge, the latest initiative to create a Digital Health Act<sup>72</sup> is the first attempt comprising concepts such as telemedicine, eLearning in medicine, and electronic medical record in a comprehensive law that recognizes both the need of ICT development for healthcare expansion.

A solid ICT based health policy would require to:

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<sup>71</sup> INEGI, “Censo de Población y Vivienda 2020”, 2021. Available at: <https://www.inegi.org.mx/programas/ccpv/2020/default.html#Tabulados>

<sup>72</sup> Gaceta del Senado de la República (2021). “Iniciativa que reforma y adiciona diversas disposiciones de la Ley General de Salud, en materia de telesalud y telemedicina”. Available at: <https://bit.ly/3r1VV2H>

- Understand the complementary nature of mHealth solutions. Mobile technologies contribute to provide better healthcare services since they provide patient's monitoring capacity, and more efficient use of healthcare resources, among other benefits.
- Encourage digital health ecosystem development through collaboration mechanisms between private and public initiatives to promote the creation, adoption, and improvement of mHealth solutions such as apps related to wellbeing and patients monitoring.
- Take advantage of the high adoption of mobile technologies in Mexico to encourage the use of mHealth solutions among patients and clinicians.
- Implement an ICT affordability policy to tackle cost-related barriers. The CIU has developed a series of recommendations: i) tax policy that reduces the purchase price to consumers, ii) subsidies from government to promote adoption in targeted social groups, and iii) low interest rate public loans, and government acting as joint guarantor for private loans, both instruments aimed at acquiring mobile devices.
- Development of mHealth public policies including improvement of digital skills among population and promotion of an app economy.
- Update current regulation (NOM-035-SSA-2013) to consider health information from mobile technologies as actual health information. This would facilitate the protection of users' information since NOM-035 establishes a data protection regulatory framework.
- Great care should be taken on regulation attempts regarding medical software: if its scope includes devices (such as smartphones or wearables) as medical devices their adoption and accessibility can be negatively impacted
- Define quality standards for telemedicine, mHealth solutions, and systems of healthcare information to guarantee interoperability.

All this effort will translate into new spaces of opportunity both for public and private initiatives to respond the increased demand of healthcare services. As it can be seen from Digital IMSS example, it would be the first step to save resources to healthcare institutions reducing unnecessary procedures and improving administrative



tasks, creating a cost-effective solution to healthcare provision. As well as paving the way to include mHealth into the digital economy.

Finally, on the side of the demand it would mean the chance to work towards UN goal to reach universal healthcare since mHealth is a synonym of ensuring healthy lives and well-being for all.

## 8. Appendix

### Argentina

An application developed by the Government of Argentina allows self-assessments of symptoms, to determine chances of contracting the disease. Health related data and information are collected and processed through this tool.

In Buenos Aires, an auto test was developed by the Government to help appropriate action if residents have symptoms of COVID-19.<sup>73</sup> The App provides likelihood of being infected and measures to take. Data entered is stored and verified.

### Colombia

Created nationwide by the Government of Colombia, *CoronAPP*, provides the knowledge on the evolution of the disease. This, allows its citizens to learn the behavior of the virus and its design containment and prevention measures.<sup>74</sup>

### Cuba

The application *COVID-19 InfoCU*, developed by Infomed, is available for mobile devices, with updated and reliable information on COVID-19. This App is nourished by content on the site "Coronavirus Infections", offering guidance of professionals of the National Health System, alongside basic information about the coronavirus, the infections it causes and the latest on the development of this pathogen, such as confirmed cases, associated deaths, and affected countries.<sup>75</sup>

### Bolivia

In Bolivia, an app called *Coronavirus Bolivia* includes all the official information about the disease. Among the most relevant characteristics included are preventions, symptoms, frequently asked questions, emergency numbers, official communications, and latest news.<sup>76</sup>

### Ecuador

A medical management app, *SaludEC*, developed by the Government of Ecuador, allows communication services, patient registration and self-testing, to help its citizen through the pandemic.<sup>77</sup>

### Singapore

Via Bluetooth, *Trace Together*, technology developed by SGUnited, GovTech and the Ministry of Health, allows tracing the contacts of infected individuals. It also makes provides notifications on the risk of contracting the disease.<sup>78</sup>

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<sup>73</sup> Gobierno de la Provincia de Buenos Aires. "Autotest Coronavirus", 2021. Available at: <https://bit.ly/3gQ3fcw>

<sup>74</sup> Ministerio de Salud y Protección Social. "CoronApp - Colombia, la aplicación para que conocer la evolución del coronavirus en el país", 2020. Available at: <https://bit.ly/3xCmXhG>

<sup>75</sup> Infomed, Red de Salud de Cuba. "Disponible aplicación desarrollada por Infomed sobre COVID-19", 2020. Available at: <https://bit.ly/3e3KY9P>

<sup>76</sup> Estado Plurinacional de Bolivia. "Descarga la app Coronavirus Bolivia", 2020. Available at: <https://bit.ly/3t9u91f>

<sup>77</sup> App Store, Ministerio de Salud Pública de Ecuador. "SaludEC", 2021. Available at: <https://apple.co/3u5FLDY>

<sup>78</sup> Singapore Government Agency. "Help speed up contact tracing with TraceTogether", 2020. Available at: <https://bit.ly/3u5FQHM>

## Norway

*FHI APP*, application developed to voluntarily track coronavirus infection from user movement. It collects data via GPS and Bluetooth, storing it in the cloud. If a user is found to be infected, phones that have been in close contact, for the past 14 days, can be traced. It also provides notifications to users who have been close to the infected person, so they can act accordingly.<sup>79</sup>

## Israel

*Hamagen*, application developed by the Government of Israel, tracks the whereabouts of users, comparing it with known movements of those diagnosed with COVID-19, to verify if they crossed over within 14 days. If the app finds a match, it links the smartphone owner to the Ministry of Health website for information on actions to take and how to register for quarantine.<sup>80</sup>

This application was developed when infections topped 1,000 in Israel, with the strategy to isolate people who were already infected. In addition to this, a technology called *Vocalis Health*, uses voice recognition to detect and monitor health status.<sup>81</sup>

## Poland

Developed by the National Government of Poland, a free app for iPhone and Android allows the police to control violations of quarantine measures. The App request phone number and reference photo to be used. It verifies the individual, through facial recognition and location, replicating a visit from a police officer. It also provides access to relevant health information.<sup>82</sup>

## Iceland

Official Government application, called *Ranking C-19*, collects GPS location through mobile devices to mitigate the pandemic. If the owner of a device is infected, the Health Directorate will ask him to share location data for contact tracing.<sup>83</sup>

There are indications that countries with smaller populations find it easier to gain collective acceptance for their applications. Thus, with a population of less than 400,000 inhabitants, more than 40% of the population downloaded the app one month after its launch.

## Austria

An application developed by Cruz Roja, *Stopp Corona*<sup>84</sup>, allows individuals diagnosed or with symptoms, to send an automatic message to everyone registered.

## Spain

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<sup>79</sup> Norsk rikskringkasting AS. "FHI-app skal lagre info om dine bevegelser i 30 dager", 2020. Available at: <https://bit.ly/3e41SVA>

<sup>80</sup> The Times of Israel. "Health Ministry launches phone app to help prevent spread of coronavirus", 2020. Available at: <https://bit.ly/331vTil>

<sup>81</sup> Infobae. "Israel prueba una innovadora aplicación para identificar la "huella" vocal de los pacientes con coronavirus", 2020. Available at: <https://bit.ly/333MYbP>

<sup>82</sup> Privacy International. "Poland: App helps police monitor home quarantine", 2020. Available at: <https://bit.ly/3aPls6i>

<sup>83</sup> App Store, Landlaeknisembaettid. "Rakning C-19", 2021. Available at: <https://apple.co/3vsLHqS>

<sup>84</sup> Stopp Corona. "Die App im Kampf gegen das Coronavirus", 2021. Available at: <https://bit.ly/3nx2ypI>

The Government, alongside EricTel, developed COVID19.EUS85, whose objective is to weave a citizen network to help contain the disease, through its prevention and detection. It uses the same monitoring model of the WHO and the European Center for Disease Control. It works through the following objectives:

- Prevent: Everyone can download it, add their health status, or include family, friendship or work and education. By doing this, every user is interconnected and receive recommendations, as well as helping to monitor their health and the status of others.
- Follow-up of confirmed cases: This allows the Department of Health a better understanding and follow-up, always anonymously, symptomatic individuals. This allows to focus efforts on those who need it the most.
- Provide support from health professionals: Daily coverage to people in quarantine. Health professionals will solve doubts and necessities.
- Concentrations of cases: Reinforcement for epidemiology teams, which be able to locate the places where cases are located and thus, conduct more individualized diagnostic and interventions in areas of high transmission.

In turn, Stop Covid 19 Cat, uses geolocation of mobile devices to track infected people and take advantage of data to develop public policies based on the evolution of the pandemic. It generates heat maps according to collected data, allowing health authorities to locate cases of risk. In this way, it is possible to decongest the lines of attention.<sup>86</sup>

When the second wave of the coronavirus grew in Spain, the Government launched Radar Covid. This app informs about risk zones and if people around had been tested positive. However, this application has received a lot of criticism.

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<sup>85</sup> Departamento de Salud. “APP COVID-19.EUS”, 2021. Available at: <https://bit.ly/3u4cnhu>

<sup>86</sup> RTVE. “Aplicaciones creadas para Descongestionar Teléfonos de Emergencia”, 2020. Available at: <https://bit.ly/3t3lrRf>

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