



*WORKING PAPER SERIES*

# ELECTRONIC HEALTH RECORD IN MEXICO

The Competitive Intelligence Unit

## ABSTRACT

This paper analyses the factors affecting the implementation of a universal Electronical Medical Record (EMR) in Mexico; from technical, operative, and economic aspects to the legal framework ruling the Electronic Health Record (EHR) system.

The research found that the implementation of an EHR involve the creation of a culture of quality in healthcare because its methods and information can be used to thrive education, research, treatments, and evaluation of medical practices. Additionally, the digital collection and storage of medical data will empower Mexico's healthcare industry not only to reach more patients, but to also provide a powerful tool to reverse the trend of chronic illnesses such as diabetes and obesity, both quite problematic in the country.

It also empowers the patient who has control of his/her records and can share them with the health worker or app of its preference.

On the other hand, we found that there are important EMR implementation efforts within the Mexican healthcare system, but there are still challenges to reach a universal system , some related with connectivity gaps, while others with policy and financial aspects as well as the legal framework enforcing interoperability, and the very nature of the Mexican health system (fragmentation, and diversity of authorities) which also represent a solid barrier for a common and interoperable platform . This current framework is call for promoting the creation of more EMR efforts and for an interoperable platform that allow them to share information.

To implement an interoperable platform for all different EMR solutions, we recommend:

- Develop healthcare public policies which contemplate and promote the adoption of EMR in all, public and private, health institutions across the country, and adoption of ICT devices such as smartphones and wearables to access and feed the system.
- Promote an interoperable platform that allows the integration of information from existing and future EMR.
- Promote mobile devices and software such as Smartphones, and mobile applications, as well as wearables, as the pivotal technologies for a universal EMR policy; given de high penetration level of mobile devices in Mexico.
- Develop a training model for health-related students and clinicians on the use of EMR.
- Procure the enforcement of regulation regarding interoperability of EMR systems.
- Include the concept of a universal EMR in the General Health Law, as well as the adoption of ICT devices such as smartphones and wearables to easily access and feed the system by patients.
- Update the current legal framework (NOM-035-SSA3-2012) to ensure the easy and secure access to their medical data by patients though interoperable digital technologies such as smartphones and wearables
- Adjust the NOM-024-SSA3-2012 to be compatible with international experience such as the 2016 21st Century Cures Act (United States), particularly the ONC Cures Act Final Rule which recently went into effect. This rule "...is designed to give patients and their healthcare providers secure access to health information. It also aims to increase innovation and competition by fostering an ecosystem of new applications to provide patients with more choices in their healthcare".
- Promote within the NOM-024-SSA3-2012 mechanisms that allow the incorporation of health information from devices such as wearables.

- Promote pilot programs of universal EMR between private and public health providers.
- Build up an EMR system linked with technologies such as wearables, blockchain, and mobile technologies.
- Advocate for a connectivity policy complementary to health policy to expand EMR access, specifically in the southern states of the country.
- Promote connectivity in public healthcare centers through existing mechanisms such as the Red Compartida. According with information of the Ministry of Communications and Transportation (SCT by its acronym in Spanish) and the Energy Federal Commission (CFE by its acronym in Spanish), it is possible to estimate around 11,000 healthcare public sites with connectivity requirements.

## GLOSSARY OF TERMS AND DEFINITIONS

**Electronic Medical Record (EMR):** Medical records that are created, managed, and consulted by members of the same healthcare institution.

**Electronic Healthcare Record (EHR):** Medical record that gathers information of a patient from a variety of healthcare institutions.

**Hospital's Information System (HIS):** System that is designed to manage the financial, clinical, and operative aspects of a medical institution and can be linked to several EMRs.

**Information and Communications Development Index Mexico (IDTMex):** Adaptation of the IDT to Mexico. **Instituto Mexicano del Seguro Social (IMSS):** Healthcare sub-system for workers of the private sector based on contributions by the firms and the workers themselves.

**Instituto del Seguridad y Servicios Sociales de los Trabajadores del Estados (ISSSTE):** Healthcare sub-system available to workers of the State.

**Personal Healthcare Record (PHR):** Medical Record that is collected, shared, and managed by the patient.

**Petróleos Mexicanos (PEMEX):** Refers to the healthcare sub-system for the workers of PEMEX (state-owned company).

**Secretaría de la Defensa (SEDENA):** Refers to the healthcare sub-system for people at the army.

**Secretaría de Marina (SEMAR):** Refers to the Healthcare sub-system for the navy.

**The Organization for Economic Cooperation and Development (OECD):** International organization that works to build better policies for better lives. Their goal is to shape policies that foster prosperity, equality, and well-being.

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## 1. INTRODUCTION

The health record is a major step towards the realization of the right to health. It provides historic information about our health condition, and the different procedures conducted by healthcare professionals. It also involves patients' written, graphic, electronic, magnetic, electromagnetic, and other information from healthcare interventions/apps. This information serves different purposes but contributes to an optimal provision of healthcare services.<sup>1</sup>

Currently, our medical and health information is scattered all around the healthcare services providers' files. Successful cases of electronic record have proven benefits from unifying and making vital medical information easily transferable. To date, Mexico has achieved some milestones towards the creation of the electronic health record with the issuance of the Official Mexican Norm NOM-024-SSA3-2012 in 2012.<sup>2</sup>

This NOM establishes mechanisms for healthcare services providers, public and private, to send, record, exchange and improve electronic records. Moreover, the regulation seeks guaranteeing interoperability, processing, interpretation, confidentiality, and security by implementing information standards for these records. Electronic Health Record (EHR) systems are already available in some states in Mexico; however, each entity has different information systems which are not interoperable among them. This situation coupled with the presence of various health subsystems and the lack of coordination of health authorities (federal and state authorities), constituted a call for promoting standardization, and interoperability at national level of EHR systems.

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<sup>1</sup> Diario Oficial de la Federación, "Official Mexican Norm NOM-004-SSA3-2012, Del Expediente Clínico", Estados Unidos Mexicanos, 29 de junio de 2012. Available at: [http://dof.gob.mx/nota\\_detalle\\_popup.php?codigo=5272787](http://dof.gob.mx/nota_detalle_popup.php?codigo=5272787)

<sup>2</sup> Diario Oficial de la Federación, "Official Mexican Norm NOM-024-SSA3-2012, Sistemas de información de registro electrónico para la salud. Intercambio de Información en salud", Estados Unidos Mexicanos, 9 de noviembre de 2012. Available at: [http://dof.gob.mx/nota\\_detalle\\_popup.php?codigo=5272787id](http://dof.gob.mx/nota_detalle_popup.php?codigo=5272787id).



The following work is divided in four sections. In the first one the concept of Electronic Health Record, and the benefits of a system -supported with international experience- are introduced. In the second part, the legal framework around the implementation of an EHR system is studied both at international and national level. The case of the Official Mexican Standard NOM-024-SSA3-2012 regulating the interoperability and design of an EHR system is analyzed. In the third part, the main factors of feasibility (technical, economic, and operative) are introduced as well as information regarding the accomplishment of each one. Finally, in the last section the conclusions are given.

## 2. ELECTRONIC HEALTH RECORD

### I. DEFINITION AND CATEGORIES

The medical record in the age of digitation is “*an informatics system in which patient data is collected in a digital format and can be accessed by authorized users*”.<sup>3</sup> In Mexico, the Ministry of Health recognizes four types of digital records: Electronic Medical Record (EMR) that is created, managed and consulted by members of the same healthcare institution; Electronic Healthcare Record (EHR) that gathers information of a patient from a variety of healthcare institutions; Personal Healthcare Record (PHR) that is collected, shared, and managed by the patient; and the Hospital's Information System (HIS) that is designed to manage the financial, clinical and operative aspects of a medical institution and can be linked to several EMRs.<sup>4</sup>

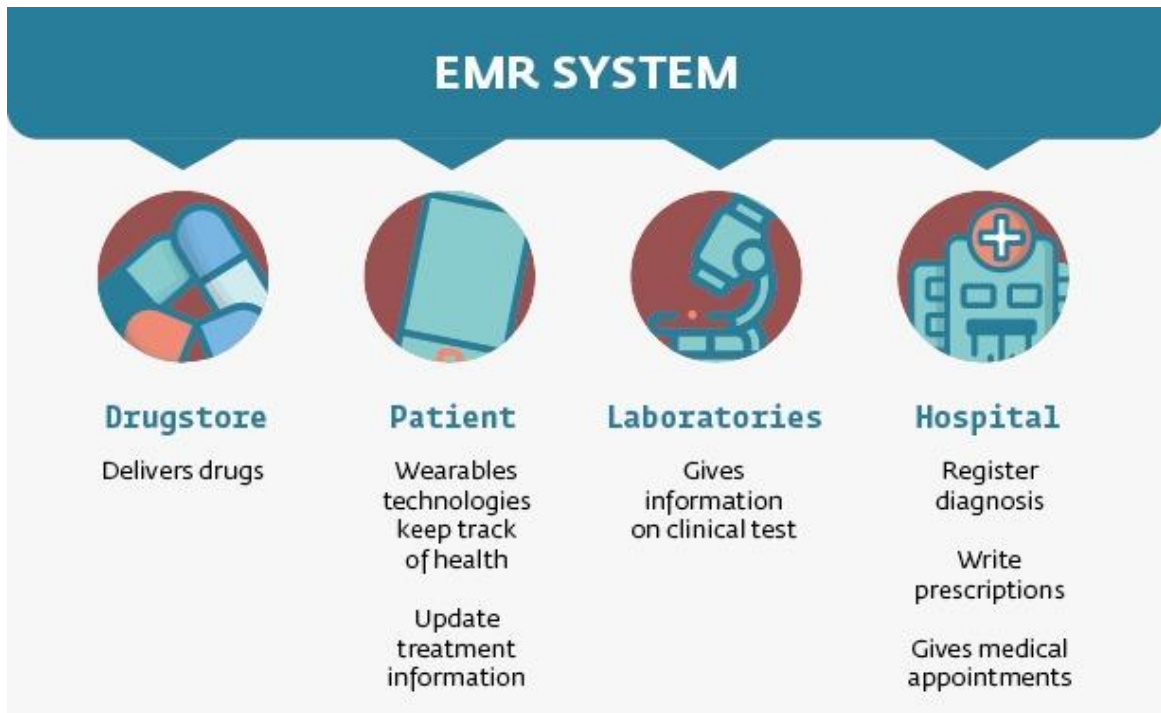
A universal EMR ought to collect information on medical treatments, surgical notes, ambulatory notes, lab exams, medical consultations, and hospital notes from both the private and public healthcare systems. For example, The Figure 1 illustrates some of the sources of information that feed a universal EMR system. To reach this level of data gathering the Mexican healthcare system faces economical, technical, and operative challenges.

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<sup>3</sup> Nancy Gertrudis Salvador, “Expediente Clínico Electrónico”, Congreso Internacional de Tecnologías Informáticas para la Educación en Salud, Tuxtla Gutiérrez, Chis. México, 2009.

<sup>4</sup>Ibid.p.12

**Figure 1. Sources of information of an EMR system**



Source: The CIU, 2020.

## II. *BENEFITS OF AN EMR SYSTEM*

There are several benefits of an electronic medical record system (EMR) such as better productivity within the operations in the healthcare sector, and reduced opportunity cost for users. The benefits multiply by implementing interoperability among EMR systems since the integrated information facilitate better management of healthcare policies.

Additionally, it has been estimated that an effective application of a universal electronic medical record could reach up to thirty-eight billion pesos in savings to the Mexican healthcare system, which suggests not only the importance of implementing EMR systems, but the gains form integrating these systems into an interoperable platform. These gains will come mainly from reducing medical negligence and the waste of medication.<sup>5</sup> According to Jorge Alfredo Ochoa Moreno, with an EMR system, clinicians would be able to diagnose better in terms of accuracy and pertinence because of direct

<sup>5</sup> Secretaría de Salud, "Manual del Expediente Clínico Electrónico", México, 2011.p.21

access to lab results, this information would be available at any medical center and, ideally, the EMR would register the medical condition of the patient from birth to death.<sup>6</sup>

The gains from the implementation of an EMR system also involves creating a culture of quality in the provision of healthcare services because the information that provides can be used to thrive education, research, and evaluation of medical practices. Also, this kind of systems allow better observance on the realization of the right of the patient to choose freely their medical interventions because it must be submitted with their proof of consent. It also protects the right to privacy because all the data related to the medical condition of the patient belongs to the patient so it must be treated as confidential.<sup>7</sup>

On the other hand, the benefits to research of gathering the information of a population in a EMR system provides timely and high-quality data that can, through statistical analysis, help plan, rule, coordinate and evaluate the overall health system. It also provides mechanisms to better understand and attend diseases well spread among the population.

One of the main benefits of EMR system is the ability to store medical records in a more secure fashion, allowing easier access to the information collected and making the data available to anyone who requires it and has authorized access. It also minimizes errors by standardizing patient records across the board, as well as maximizing cost-efficiency by offering the ability to share information instantly, speeding up patient care and saving time and money, as well as decreasing the risk of misplacing information.

The Mexican Healthcare System provides some successful experiences like the “Telesalud” program of the Instituto de Seguridad y Servicios Sociales para los Trabajadores del Estado (ISSSTE) which was a global pioneer and was cataloged by the World Healthcare Organization (WHO) as the most productive in Mexico and in Latin

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<sup>6</sup> José Alfredo Ochoa Moreno, “El expediente clínico electrónico universal en México”, Boletín CONAMER-OPS, Vol. 3 N. 18, 2018.p.2

<sup>7</sup> Diario Oficial de la Federación, “Official Mexican Norm NOM-004-SSA3-2012, Del Expediente Clínico”, Estados Unidos Mexicanos, 29 de junio de 2012. Available at: [http://dof.gob.mx/nota\\_detalle\\_popup.php?codigo=5272787](http://dof.gob.mx/nota_detalle_popup.php?codigo=5272787)

America.<sup>8</sup> There are also several experiences of EMR system adoption taken from the international and national experience.

### III. *INTERNATIONAL EXPERIENCE*

Around 1960, the healthcare industry began to explore the development of EMR systems focused on clinical data management, but it was not until 1972 that the Regenstrief Institute developed the first EMR system. Due to excessive costs, the systems were only used by government hospitals and visionary institutions. In the 1990's, the technological innovation, the cheaper access to ICT and the emergence of the Internet allowed for faster, easier access to information and the introduction of health information online, setting the stage for web-based EMR systems.<sup>9</sup>

In 1991, the Institute of Medicine said that by the year 2000, physician's offices should be using computers in their practice to improve patient care. Although it was not turned into law, the Institute did provide a variety of recommendations to achieve that goal. In 1996, the Health Insurance Portability and Accountability Act (HIPAA) was introduced in response to issues facing healthcare coverage, privacy, and security in the United States.

In the early 2000's, the ability to access information remotely made the electronic method for keeping records more appealing and affordable. In the United States, at the end of the first decade of this century, the budget for healthcare IT projects was doubled, a new sub-cabinet position of National Health Information Coordinator was created, and a call for an industry-wide adoption of electronic health record systems was made by 2014.<sup>10</sup>

There are seven main reasons why IT-based medical care paradigms are emerging:<sup>11</sup>

- 1) Paper-based system to support clinical care is increasingly non-viable.
- 2) Human memory-based medicine is increasingly unreliable.
- 3) Clinical data acquisition has become a business imperative.
- 4) Consumer expectations for improved care and service are rising.

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<sup>8</sup> Secretaría de Salud (2011). Manual del Expediente Clínico Electrónico.P.23

<sup>9</sup>The University of Scranton, "EMR: The Progress to 100% Electronic Medical Records", 2020. Available at: [https://elearning.scranton.edu/resource/health-human-services/emr\\_the-progress-to-100-percent-electronic-medical-records](https://elearning.scranton.edu/resource/health-human-services/emr_the-progress-to-100-percent-electronic-medical-records)

<sup>10</sup> Ibidem.

<sup>11</sup> Tim Scott, et al., "Implementing an Electronic Medical Record System", CRC Press, London, 2007. Available at: <https://www.taylorfrancis.com/books/9781315378534>

- 5) Prevalence of chronic diseases is steadily rising, requiring closer monitoring of patients.
- 6) Insurers are demanding more accountability from providers for the cost and quality of care, as well as patient outcomes.
- 7) Innovative technologies make possible to improve care in ways not heretofore possible.

Worldwide, there are already a variety of proven cases of EMR systems that are helping and improving the quality of the healthcare system. Every case has peculiarities that separate them from each other, and thus, regulation on this subject must aim for each country EMR necessities and available resources.

#### *a. AUSTRALIA*

The Australian Digital Health Agency created a digital medical history where each patient can access relevant information about their medical history from any device connected to the internet like wearables. Healthcare providers can access important medical information such as allergies, current medications, diagnosed medical conditions and analysis results. The user has full control of their registration and can restrict their access if they wish.

Due to its easy access any hospital, both public and private, could use this system, around seven hundred public hospitals and health services throughout Australia are connected to *My Health Record* and send summaries for any patient who use it. Every month more people are using this system, in addition to almost two hundred private hospitals that are part of the electronic health system.<sup>12</sup>

Benefits of using this system includes real time patient information, safer and more reliable care, less paperwork, more time with patients, powerful clinical and management data, world class clinical care and research, and improved efficiency. In June 2018, a study showed that financial and economic benefits have been achieved across patient quality

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<sup>12</sup> Australian Digital Health Agency, "My Health Record", Australian Government, 2020. Available at: <https://www.myhealthrecord.gov.au/>

and safety, operational service improvement and direct financial savings at the Princess Alexandra, Mackay Base, Cairns, Townsville, and Queensland Children's Hospitals.<sup>13</sup>

Through Medicare which "...covers all of the cost of public hospital services [...] some or all of the costs of other health services [...] and makes some prescription medicines cheaper..."<sup>14</sup> Australian health authorities seek, in a coordinated way, the universal coverage. Also, different government levels share responsibility in managing the healthcare system<sup>15</sup>. These two characteristics of the health system facilitate the implementation of a single EMR platform.

#### *b. ESTONIA*

In 2008, Estonia became the first country in the world to implement a national system of electronic health records "*from birth to death*" for almost all citizens (99% of patients have a digital record).

The Electronic Health Record (e-Health Record) is a national system that integrates data from different Estonian health care providers to create a common record that is accessible to all patients online.

Operating very similarly as a centralized national database, the Electronic Health Record retrieves data from various medical information providers, which may be using different systems, and presents it in a standardized format through the e-Patient portal. A powerful tool for clinicians that allows them to easily access a patient's records from a single electronic file, and read test results as they are entered, including image files such as X-rays from remote hospitals.

To ensure the integrity of retrieved electronic medical records, as well as system access records, blockchain technology is used.

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<sup>13</sup> Queensland Health, "Integrated electronic medical record (ieMR)", Queensland Government, 2019. Available at: <https://www.health.qld.gov.au/clinical-practice/innovation/digital-health-initiatives/queensland/integrated-electronic-medical-record-iemr>

<sup>14</sup>Australian Government. "The Australian health system". Available at: <https://bit.ly/3mMoDil>

<sup>15</sup> Id.

For example, in an emergency, a physician can use a patient's identification code to read valuable information such as blood type, allergies, treatments, ongoing medications, or pregnancies.

The system also collects data for national statistics purposes, so the ministry can measure health trends, track epidemics, and ensure that its health resources are spent efficiently.

Additionally, through the e-Patient portal, patients have access to their own records with the use of an electronic ID card. Patients can review current doctor visits and prescriptions, and verify which doctors had access to their files.<sup>16</sup>

The healthcare system basis is health insurance paid by employers. Hospitals are mainly public, while primary care and pharmacies are private services. The system depends on external funding since "...providers are [...] dependent on external (European) funding for capital investments, rather than seeking self-sufficiency..."<sup>17</sup>. This happens also with health innovation:

The Ministry of Social Affairs received funding from the European Union (EU) Structural Funds in 2005 for the development of four E-health projects: Electronic Health Records (EHR), Digital Images, Digital Registration and Digital Prescription. Of the total costs of these E-health projects (approximately €2.2 million), 75% is funded by the EU and 25% by the Estonian State.<sup>18</sup>

### *c. FINLAND*

The Finnish digital health system under Kanta Services, a state-owned company responsible for producing digital services for the health and social welfare sector, benefits both citizens and providers of social assistance and healthcare services.

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<sup>16</sup> Enterprise Estonia, "e-Estonia", 2020. Available at: <https://e-estonia.com/solutions/healthcare/e-health-record/>

<sup>17</sup> OECD/European Observatory on Health Systems and Policies (2017), Estonia: Country Health Profile 2017, State of Health in the EU, OECD Publishing, Paris/European Observatory on Health Systems and Policies, Brussels. <http://dx.doi.org/10.1787/9789264283350-en>

<sup>18</sup> Adele-mari Kleynhans (2011). "Is South Africa ready for a national Electronic Health Record (EHR)?" Available at: <https://bit.ly/3wfuC5q>



Kanta's basic services have been implemented in stages, since early 2017, all prescriptions have been electronically issued to the Kanta service. Users of Kanta's services include citizens, pharmacies, and health operators – both public and private -.

Kanta service contains the patient data repository, a health data system based on patient data. This system allows centralized archiving of electronic patient data, as well as its active use and storage. Patient data repository plays a key role in the exchange of information between both public and private healthcare providers.<sup>19</sup>

The particularity of the Finland's health system is its decentralization. Over three hundred municipalities are responsible for organizing and financing health care. A municipality can provide services itself or in collaboration with other municipalities, as well as purchasing services from other organizations. They are responsible for the provision of primary care. At national level, the Ministry of Social Affairs and Health is responsible for implementing health policies.<sup>20</sup>

#### *d. UNITED KINGDOM*

None of the existing or planned EMR system in the world have the scale envisaged for the EMR currently being implemented by the UK National Health Service. The NHS National Programme for Information Technology (NPfIT) is currently budgeted at over six billion pounds and projected to cost more than twenty billion pounds over the next 10 years. It features a national electronic medical record and integrated functions including documentation, care management, ordering, messaging, analysis and reporting, access to knowledge resources and patient website access.<sup>21</sup>

Orion Health is the UK's largest provider of Integrated Digital Care Records (IDCR's), a system which can integrate a citizen's health and care data from disparate systems across

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<sup>19</sup> KANTA, "What are the Kanta Services?", Government of Finland, 2020. Available at: <https://www.kanta.fi/en/what-are-kanta-services>

<sup>20</sup> OECD/European Observatory on Health Systems and Policies (2017), Finland: Country Health Profile 2017, State of Health in the EU, OECD Publishing, Paris/European Observatory on Health Systems and Policies, Brussels. <http://dx.doi.org/10.1787/9789264283367-en>

<sup>21</sup> Tim Scott, et al., "Implementing an Electronic Medical Record System", CRC Press, London, 2007. Available at: <https://www.taylorfrancis.com/books/9781315378534>

a geography into a single view. From this, clinicians and care givers can utilize additional functionality such as care planning, test ordering and referral management.

Orion Health's IDCR solution provides data integration and visualization in line with the Local Health and Care Record (LHCR) program. LHCR works to create integrated care records across hospitals, community services and social care. With several successful programs already established, benefits of IDCR's across patient outcomes, efficiency and workflow are proven.<sup>22</sup>

In UK, health services are mainly funded from general taxation, while health insurance plays a "supplementary role in the system (3.1 % of total health expenditure) and out-of-pocket (OOP) spending is low (16 %) compared to most other EU countries."<sup>23</sup>

To see more examples of the EMR system adaptation internationally please refer to the Appendix section.

#### IV. MEXICAN EXPERIENCE

In 2013, Mexico was in the phase of implementing and disseminating the use of the EMR to unify information records, focusing on availability, accessibility, and effectiveness. Through the Official Mexican Norm NOM-024-SSA3-2012, the functional objectives and functionalities that the products of EMR systems must observe to guarantee interoperability, processing, interpretation, confidentiality, and security, were established.

One of the medium-term strategies was to get all states to implement their own EMR systems and to interoperate with each other. The EMR is designed to generate operating standards and improve database administration, data transfer and health security systems. So far, Mexico had made a degree of progress in the implementation of the EMRs, but with different degrees of development, even before NOM-024 was issued.<sup>24</sup>

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<sup>22</sup> ORION HEALTH, "Solutions for Integrated Digital Care Records", 2020. Available at: <https://orionhealth.com/uk/solutions/integrated-digital-care-records/>

<sup>23</sup> OECD/European Observatory on Health Systems and Policies (2019), United Kingdom: Country Health Profile 2019, State of Health in the EU, OECD Publishing, Paris/European Observatory on Health Systems and Policies, Brussels.

<sup>24</sup> CONAMED, "Boletín CONAMED", Secretaría de Salud, 2019. Available at: [http://www.conamed.gob.mx/gobmx/boletin/pdf/boletin26/Besp26\\_10.pdf](http://www.conamed.gob.mx/gobmx/boletin/pdf/boletin26/Besp26_10.pdf)

In Mexico, as we can see in the definition of modules according to the Health Ministry, we seek to obtain results in several of the expected benefits of an EMR, in a quick analysis we can associate the following categories with its expected benefits:

- Medical care: quality improvement, better control of supplies, reduction of time
- Technological infrastructure: Availability of the file through interoperability, reduction of time in delivery of studies.
- Decision support: Improvement in the timeliness and quality of hospital statistics, process improvement.

Apart from the benefits reported in the integration of information and improvement of processes, there are studies that link the quality of care through adequate monitoring of the defined processes and the quality of filling in the documents present in the medical unit, this is where the definition of an EMR as a comprehensive process and quality control tool gains great force.

In a study conducted in 18 Hospitals in Guadalajara, it was found that the lack of standardization of processes and the presence of a deficient information system is identified in 22% of cases as an inhibitor of quality, as well as a deficient filling of the clinical file in 33% of the cases.

#### ***α. SICOHOSP: THE ELECTRONIC MEDICAL RECORD OF NAVY'S HEALTH SYSTEM***

The Hospital Control System (SICOHOSP) is an automated tool designed by the Ministry of the Navy, with the main objective of automating functions of medical attention processes of the naval medical establishments.

SICOHOSP is an EMR system that records information on medical care for the first and second levels; considering external consultation, emergencies, hospitalization, and operating rooms among some of the service areas to which it provides technological support to health professionals. Additionally, it contemplates the registration of information on more than thirty specialties, among which are obstetrics, internal medicine, pediatrics, and general surgery.

***b. MEXICO CITY: MEDICAL ADMINISTRATION AND HOSPITAL INFORMATION SYSTEM (SAMIH)***

The decision to digitize Mexico City's health care system and implement electronic medical records within its hospitals is an important first step in improving overall public health. The digital collection and storage of medical data empower Mexico's healthcare industry to not only reach more patients, but to also provide a powerful tool to reverse the trend of chronic diseases such as diabetes and obesity.

The implementation of the Medical Administration and Hospital Information System (SAMIH), conducted in a record time of two years, has enabled the digitization of the healthcare system and the creation of an Electronic Health Record system in the thirty-one hospitals belonging to the network of Mexico City Government.<sup>25</sup>

It's the most important project in health matters that incorporates the use of Information and Communication Technologies, allowing the modernization of the infrastructure and health information systems through the implementation and commissioning of SAMIH, with an EMR in Hospital Medical Units that depend on the Health Ministry of the Mexico City (Secretaría de Salud de la Ciudad de México or SEDESA).

SAMIH platform is classified as one of the best in complying with the HL7 (Health Level Seven) protocol, an international standard for EHR agreed by more than 1,600 members from over 50 countries, including around 500 corporate members representing healthcare providers, government stakeholders, payers, pharmaceutical companies, vendors/suppliers, and consulting firms.<sup>26</sup> Some outstanding benefits that will facilitate patient care include a unique identification and unified electronic medical history, as well as the reduction of waiting time, better security and confidentiality that will facilitate care.

The administration and storage of the database, images, and laboratory studies will have two data centers that will allow interoperability between the Hospital Medical Units.

Having this platform reinforce management and clinical care processes, aligning with the best practices established by the General Health Council. The multiple benefits and

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<sup>25</sup> CONAMED, "Boletín CONAMED", Secretaría de Salud, 2019. Available at: [http://www.conamed.gob.mx/gobmx/boletin/pdf/boletin26/Besp26\\_10.pdf](http://www.conamed.gob.mx/gobmx/boletin/pdf/boletin26/Besp26_10.pdf)

<sup>26</sup> HL7, "About HL7", HL7, 2021. Available at: <https://www.hl7.org/about/index.cfm?ref=nav>

advantages of the implementation of SAMIH will be reflected in the following three primary areas: Patients, Health Professionals and Hospital Institutions:

- Resource efficiency and cost reduction
- Increased security and unique identification of the patient
- Reduction of waiting times for the beneficiary
- Record of the patient's health situation: allergies, vaccines, family history, toxic habits and, therefore, better quality in the provision of health services
- Simplicity and agility in the appointment of patients, avoiding unnecessary travel

In addition, SAMIH will facilitate the obtention of sanitary statistics necessary to define efficient comprehensive public health programs.

The implementation has implied the technological modernization of hospitals, especially in terms of installation and configuration of structured cabling, the delivery of 2,000 personal computers, seven hundred printers, 2,000 no-breaks, twenty-nine servers, two storage units and 153 switches.<sup>27</sup>

Since its implementation, more than four million patients have been registered in the application, of which:

- 339,645 patients have been monitored through SAMIH.
- 644,880 clinical notes made registered more than 109,720 applications and electronic prescriptions; one million 503 thousand vital signs added in the files.

#### *c. COLIMA: SAECCOL ELECTRONIC CLINICAL RECORD)*

The state of Colima has overseen the design and implementation of its own EMR, called the Administrative System of the Clinical File of Colima (SAECCOL), based on the needs and expectations of the members and users of the health system. The development of said system began in 2005, and as of 2011 implementation was achieved in all the units of the entity and the software is developed by personnel from the Ministry of Health.

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<sup>27</sup> Ministry of Health CDMX, "Close To 2 million Patients Have Been Cared for Through the Medical Administration and Hospital Information System (SAMIH)", 2017. Available at: <https://www.salud.cdmx.gob.mx/comunicacion/nota/cerca-de-2-millones-de-pacientes-se-han-atendido-por-medio-del-sistema-de-administracion-medica-e-informacion-hospitalaria-samih>

SAECCOL operates in different public health institutions (health centers and hospitals) that serve the non-eligible population, beneficiaries of Popular Insurance and the Opportunities Program, eliminated and modified by the current federal administration.

This tool was designed by the Ministry of Health and provides information that improves the quality and efficiency in the provision of health services. It uses an interconnection model that allows working locally and updating on a scheduled basis, via the state network. It has desktop application and a web site with real-time monitoring and interface connection.

The main objective of SAECCOL is to register medical interventions digitally, continuously, efficiently and with quality to satisfy the demand for health information, implementing patient data in electronic format, allowing any user to safely store and exchange their records, becoming the primary source for decision-making at all levels of care.

In an interstate collaboration, the Government of the state of Colima, through the Ministry of Health and Social Welfare, made the free transfer of the SEACCOL to the Institute of Public Health of the state of Guanajuato (ISAPEG) which will provide care for almost 3.5 million patients in Guanajuato, distributed in 612 medical units.<sup>28</sup>

#### *d. PRIVATE EXPERIENCE*

The Public Private Associations (APP, for its Spanish acronym) are projects in which a contractual relation exists between institutions from public and private sectors. APPs have been developed in countries such as England, Spain, Brazil, Chile, and Peru.

In Mexico, APPs have become a strategy to enhance accessibility, availability, and quality of healthcare services. A recent example of this takes place during the current SARS-CoV-2 pandemic, in which the Asociación Nacional de Hospitales Privados A.C. and the Consorcio Mexicano de Hospitales, agreed to provide medical attention to public and

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<sup>28</sup> Secretaría de Salud y Bienestar Social de Colima, "Manual de Implementación Expediente Clínico Electrónico SAECCOL", Gobierno del Estado de Colima, 2013. Available at: [http://www.saludcolima.gob.mx/images/documentos/4\\_a\\_1.o\\_MIM001\\_Manual\\_de\\_Implementacion\\_del\\_Expediente\\_Clinico\\_Electronico\\_SAECCOL\\_V.1.o\\_2013.pdf](http://www.saludcolima.gob.mx/images/documentos/4_a_1.o_MIM001_Manual_de_Implementacion_del_Expediente_Clinico_Electronico_SAECCOL_V.1.o_2013.pdf)

social beneficiaries of the National Health System afflicted with a condition different from COVID-19 in any of their 146 private hospitals, through twenty-seven states.<sup>29</sup>

Other private solutions, such as MedicalManik, SaludTotal, MediSel, enables physicians to create, modify, and visualize medical records and registries from computers, tablets, and smartphones. The subscription to these services includes the generation of monitoring graphs, digital prescriptions, statistical reports, attachment of captures, and remote consultation capabilities.<sup>30</sup>

Mexican Constitution establishes that healthcare must be coordinated at all levels of government (by the Federation, the states, and the municipalities); while the General Health Act establishes that not only federal authorities (the President, the General Health Council, and the Health Ministry) are health authorities but also the states.

Mexico's healthcare system is split into private and public healthcare subsystems. The public sector includes institutions providing social security, such as Instituto Mexicano del Seguro Social (IMSS), for workers of the private sector based on contributions of the enterprises and the workers- and accounts for more than 30% of people with healthcare assurance in the country, Instituto del Seguridad y Servicios Sociales de los Trabajadores del Estados (ISSSTE), Petróleos Mexicanos (PEMEX), Secretaría de la Defensa (SEDENA), and Secretaría de Marina (SEMAR), as well as programs servicing people with no social security (INSABI, local healthcare services, IMSSOportunidades). On the other hand, the private sector includes private hospitals, medical clinics, and insurance companies.

The Mexican health system has significant differences from the systems described in the international experience section where universal EMR experiences are successful. Mexico is a health system mainly funded through social insurance and presents a diversity of subsystems (system fragmentation), as well an unclear governance system. This nature of the Mexican health system discourages the creation of a platform that allow all EMR efforts to be interoperable.

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<sup>29</sup> RGT Consultores Internacionales, "Asociaciones público-privadas (APP) en el sector salud de México". Available at: <https://rgtconsultores.mx/blog/asociaciones-publico-privadas-app-en-el-sector-salud-de-mexico>

<sup>30</sup> MedicalManik, "Características Principales", Available at: <http://medicalmanik.com/#historia>

*e. CURRENT STATE OF THE ELECTRONIC CLINICAL RECORD SYSTEM IN MEXICO*

In a review of the systems reported in use by some government institutions, sixty-five are identified to be in use at a national level, of which forty are reported by the State Health Services; fifteen in National Institutes of Health and High Specialty Regional Hospitals; four at IMSS, three at ISSSTE and one at PEMEX, SEDENA, DIF and SEMAR.

Additionally, in the public sector, within the period from 2003 to August 28, 2018, 66,424 requests for access to medical records or summaries have been submitted. Of these applications, 39,595 have been presented to the Mexican Institute of Social Security (IMSS), 8,364 to the Institute of Security and Social Services of State Workers (ISSSTE), 3,155 to the National Institute of Cardiology, 2,852 to the National Institute of Respiratory Diseases, 1,874 to the National Institute of Medical Sciences and Nutrition, 2,213 to the Ixtapaluca Regional Hospital of High Specialty, 805 to PEMEX, 973 to the Ministry of Health, 685 to the General Hospital of Mexico and 393 to the National Institute of Neurology and Neurosurgery, these being the 10 obliged subjects with the highest number of requests for access to medical records or summaries.<sup>31</sup>

There are different EMR initiatives in the main health institutions of the country, however, they lack interoperability among them, preventing them from sharing information and consolidating a universal record.

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<sup>31</sup> CONAMED, "Boletín CONAMED", Secretaría de Salud, 2019. Available at: [http://www.conamed.gob.mx/gobmx/boletin/pdf/boletin26/Besp26\\_10.pdf](http://www.conamed.gob.mx/gobmx/boletin/pdf/boletin26/Besp26_10.pdf)



### 3. LEGAL FRAMEWORK

#### I. INTERNATIONAL STANDARDS

According to the World Healthcare Organization (WHO), every human being in the world should have access to superior quality health services, no matter time or place. Contrary to what takes place nowadays, this means that financial stability shouldn't be a deterministic factor of how (and if) someone is going to be treated in case of getting sick.<sup>32</sup> As such, health as a human right creates a legal obligation to ensure access to timely, acceptable, and affordable health care of appropriate quality; as well as providing for the underlying determinants of health, such as safe and potable water, sanitation, food, housing, health-related information and education, and gender equality.<sup>33</sup>

The right to health includes the freedom to control one's health and body and to be free from interference and entitlements, as well as the entitlement to access a system of health protection that gives everyone an equal opportunity to enjoy the highest attainable level of health. As such, States' have the obligation to support the right to health, reviewed through various international human rights mechanisms like the Universal Periodic Review or the Committee on Economic, Social and Cultural Rights. In many cases, the right to health has been adopted into domestic law or Constitutional law.<sup>34</sup>

A rights-based approach to health requires that health policy and programs prioritize the needs of those furthest behind; a principle that has been echoed in the *2030 Agenda for Sustainable Development and Universal Health Coverage*. This needs to be applied in three main subjects: Core principles of human rights that includes accountability, equality, non-discrimination, and participation; Core elements of right to health, including progressive realization using maximum available resources and non-retrogression; and Core

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<sup>32</sup> World Health Organization (WHO), "Health is a Fundamental Human Right", 2017. Available at: <https://www.who.int/mediacentre/news/statements/fundamental-human-right/en/>

<sup>33</sup> World Health Organization (WHO), "Human Rights and Health", 2017. Available at: <https://www.who.int/news-room/fact-sheets/detail/human-rights-and-health>

<sup>34</sup> Ibid.

components of right to health, guided by availability, accessibility, acceptability, and quality.<sup>35</sup>

Quoting Tedros Adhanom Ghebreyesus (WHO Director-General), “The enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without distinction of race, religion, political belief, economic or social condition.”<sup>36</sup>

In the pursuit of this goal, Health Level Seven International- a not-for-profit, ANSI-accredited institution- created a set of international standards, called Health Level Seven (HL7), that provide a framework for the exchange, integration, share, and retrieval of electronic health data between software applications. This is done to promote the seamless integration and interoperability between the systems of various healthcare providers, and to support clinical practice and the management of health services.<sup>37</sup>

## II. NATIONAL LEGAL FRAMEWORK

The right to health is established in the fourth article of the Constitution of the United States of Mexico:

Everyone has the right to health protection. The Law will define the bases and modalities for access to health services and will establish the concurrence of the Federation and the entities states in matters of general health, in accordance with the provisions of section XVI of article 73 of this Constitution. The Law will define a health system for well-being, to guarantee the progressive, quantitative, and qualitative extension of health services for comprehensive and free care of people who do not have social security.<sup>38</sup>

Likewise, it states that the Executive Power will oversee the policies related to universal digital inclusion, including programs as e-health and EMR promotion and adoption.<sup>39</sup>

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<sup>35</sup> Ibid.

<sup>36</sup> World Health Organization (WHO), “Health is a Fundamental Human Right”, 2017. Available at: <https://www.who.int/mediacentre/news/statements/fundamental-human-right/en/>

<sup>37</sup> HL7 International, “Introduction to HL7 Standards”. Available at: <https://www.hl7.org/implement/standards/p>

<sup>38</sup> Cámara de Diputados, “Constitución Política de los Estados Unidos Mexicanos”. p.10. Available at: [http://www.diputados.gob.mx/LeyesBiblio/pdf\\_mov/Constitucion\\_Politica.pdf](http://www.diputados.gob.mx/LeyesBiblio/pdf_mov/Constitucion_Politica.pdf)

<sup>39</sup> Ibid.p.242.

Additionally, the Ministry of Health recognizes the following laws as part of the national legal framework that supports the EMR:

- General Health Law.
- Federal Law on Protection of Personal Data Held by Private Parties.
- Federal Law of Transparency and Access to Information
- Civil code. Chapter II. Of the provision of professional services.

Likewise, it is aligned with:

- The National Development Plan.
- The regulation of the law on the provision of health care services.
- The National Health Program.
- The Sectorial Health Program 2019-2024.

It is important to mention that the Sectorial Health Program 2019-2024, defines five core objectives to reach in five years. One of it, “to improve the capacity and quality of the National Health System” endorses the adoption of IoT solutions. Specifically, it addresses the creation of the Center of Intelligence on Health which will help unify the mechanisms related to the registration, conservation and storage of information and avoid the fragmentation of information at the distinct levels of care in the sector.<sup>40</sup>

Nevertheless, it is important to mention that as Health is a subject in which the three states of government (federal, state, and municipal) have competencies, the application of Health programs respond to diverse specificities in every state and municipality. One example of this is the campaigns of vaccination of Covid-19 and how different is the process in Mexico City compared to Jalisco.<sup>41</sup>

### III. *OFFICIAL MEXICAN STANDARD NOM-024-SSA3-2012 AND INTEROPERABILITY*

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<sup>40</sup> Ministry of Health, “Sectorial Health Program”, Ministry of Health, 2019. p.265. Available at: <https://amepresmexico.org.mx/wp-content/uploads/2019/11/191001-PROSESA-2019-2024.pdf>

<sup>41</sup> Isaura López, “With its own vaccination scheme, Jalisco applies the 500,000th vaccine against Covid-19”, EL OCCIDENTAL, 30/07/2021. Available at: <https://bit.ly/3l1Vfan>

### *a. DESCRIPTION*

The NOM-024-SSA3-2012 establishes the functional objectives and functionalities that must observe the products of Electronic Health Record Systems to ensure interoperability, processing, interpretation, confidentiality, security and use of standards and catalogs of information from electronic records in Health; it is of compulsory observation in all national territory and the public, private and social sectors that provides health services and has an EMR system. It also says that the healthcare providers are the responsible ones to maintain in optimal conditions the operation of its EMR systems as well as to implement a security system to safeguard the information and guarantee the confidentiality, integrity, and privacy of it. But the monitoring of the application of this rule corresponds to the Ministry of Health and the governments of the federative entities within the scope of their respective competencies.<sup>42</sup>

To guarantee the semantic and technical interoperability several guides and formats are given, any EMR system should follow these guides and formats. Additionally, the CURP (Unique Population Registry Code in Mexico) may work as the personal ID that would help match the information of the same person from several health institutions.<sup>43</sup>

As it can be seen, this regulation is a crucial step towards the interoperability for the Mexican healthcare system, and interoperability is fundamental since, according to the Institute of Electrical and Electronics Engineers (IEEE), refers to the capability of two or more systems to exchange information and use the exchanged information.<sup>44</sup>

It is important to mention that the NOM-024-SSA3-2012 does not have an equivalent in any international or national law. Its surveillance corresponds to the Ministry of Health, and the local governments because it is a transversal topic, just as it is stated by the Constitution.

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<sup>42</sup> Diario Oficial de la Federación, "Official Mexican Standard NOM-024-SSA3-2012, Sistemas de información de registro electrónico para la salud. Intercambio de Información en salud", Estados Unidos Mexicanos, 9 de noviembre de 2012. Available at: [http://dof.gob.mx/nota\\_detalle.php?codigo=5280848&fecha=30/11/2012](http://dof.gob.mx/nota_detalle.php?codigo=5280848&fecha=30/11/2012)

<sup>43</sup> Ibid.

<sup>44</sup> IEEE Computer Society. Standards Coordinating Committee. "IEEE standard computer dictionary: a compilation of IEEE standard computer glossaries", 610. New York, NY, USA: Institute of Electrical and Electronics Engineers; 1990.

The NOM-024-SSA3-2012, that regulates the EMR systems in Mexico, defines that it is necessary to consult other three official norms to be comprehensively understood and correctly applied. These official norms are: Official Mexican Norm NOM-035-SSA3-2012, for health information; Official Mexican Norm NOM-004-SSA3-2012, for the EMR; Official Mexican Norm NOM-017-SSA2-1994, for epidemiological surveillance.<sup>45</sup>

It is of especial interest the relation between the NOM-024-SSA3-2012 and the NOM-004-SSA3-2012 because the first establishes the rules on an EMR system and the second establishes the rules for an EMR per se. Specifically, the NOM-004-SSA3-2012 defines that the EMR are as well property of the patient as property of the medical institution that provided it, it also rules that the EMR should be stored for at least five years. Additionally, this norm gives a guide to evaluate the quality of the of all medical records not only the EMR.<sup>46</sup>

The NOM-035-SSA3-2012 defines the criteria under which the design, collection, integration, processing, and diffusion of statistics on health should be.<sup>47</sup> This means that statistical analysis generated through a EMR and gathered by a universal EMR system should attend this norm.

Finally, the NOM-017-SSA2-1994 defines the diseases and risks that should be monitored with special attention to create programs of prevention and control of it.<sup>48</sup>

#### *b. CONFIDENTIALITY*

In the clinical record, in its two versions, the traditional and the electronic, two human rights converge, the right to health and the right to the protection of personal data, because on the one hand, as already stated, the information it contains is of a high degree

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<sup>45</sup> DOF, loc. cit.

<sup>46</sup> Diario Oficial de la Federación, "Official Mexican Norm NOM-004-SSA3-2012, Del Expediente Clínico", Estados Unidos Mexicanos, 29 de junio de 2012. Available at: [http://dof.gob.mx/nota\\_detalle\\_popup.php?codigo=5272787](http://dof.gob.mx/nota_detalle_popup.php?codigo=5272787)

<sup>47</sup> Diario Oficial de la Federación, "Official Mexican Norm NOM-024-SSA3-2012, En materia de información en salud", Estados Unidos Mexicanos, 9 de noviembre de 2012. Available at: [http://dof.gob.mx/nota\\_detalle\\_popup.php?codigo=5272787id](http://dof.gob.mx/nota_detalle_popup.php?codigo=5272787id).

<sup>48</sup> Diario Oficial de la Federación, "Official Mexican Norm NOM-017-SSA2-1994, Para la vigilancia epidemiológica. Intercambio de Información en salud", Estados Unidos Mexicanos, 9 de noviembre de 2012. Available at <http://www.salud.gob.mx/unidades/cdi/nom/017ssa24.html>.

of sensitivity when displaying the physical state and / or mental health of a person, give an account of their morbidity history, which can reveal conditions that generate discrimination or segregation, such as chronic degenerative or infectious diseases that limit them in work applications or rejection in society itself, which It violates the rights of equality and non-discrimination that our regulatory system also recognizes and protects.

In this regard, in the Official Mexican Standard NOM004-SSA3-2012 on clinical records, it is established that health professionals are obliged to provide verbal information to the patient, to whom they exercise parental authority, guardianship, legal representation, to relatives in some cases in terms of the law that also specifies that when a clinical summary or other evidence of the clinical record is required, the request must be in writing.

Therefore, regardless of the sector (public or private) and the applicable legislation, health service providers are obliged to comply with the following general rules regarding the handling of personal data contained in clinical records:

- a) Not to use deceptive or fraudulent means to obtain personal information.
- b) Inform the patient about the very existence of the treatment and the terms and conditions that distinguish it.
- c) Use personal data in compliance with applicable national and international legislation.
- d) Limit the use of personal information to comply with the specific purposes.
- e) Use only the personal data that is strictly necessary in relation to the intended purposes, even more so if themselves are sensitive.
- f) Keep personal data updated.
- g) Maintain the confidentiality of the personal data used.
- h) Implement security measures of an administrative nature, physical and technical that guarantee the confidentiality, availability, and integrity of personal data.
- i) Delete personal data when the purposes that gave rise to the treatment have concluded.

Likewise, health service providers must adopt preventive measures that guarantee that any technology used in medical care, including electronic medical record systems, comply with the standards required in terms of protection of personal data for their collection, save and storage.

### *c. CHALLENGES*

As stated in the Specific Action Program 2008-2013 of the National Information System in Health:

...there is ungovernability over the information contained in the EMR Systems, which has led to a lack of homologation in the production, registration, processing, and exchange of health information, causing duplication in the information generation and dissemination processes and directly affecting its opportunity and reliability.<sup>49</sup>

Additionally, it denounces the lack of procedures to guarantee the surveillance on the compliance on health information. Situation that adds up to the denounce of Ochoa, current General Directorate of Public Health Services of Mexico City, to the Pan American Health Organization about the lack of political will to implement the EMR system even though the NOM-024-SSA3-2012 is mandatory.<sup>50</sup>

Those problems are related to the very nature of the health system: i) the fragmentation of the system in several non-coordinated subsystems (social security institutions, public institutions for people with no social security, and private healthcare services), ii) the regulation (NOM-024) lacks general enforcement although is mandatory, and iii) federal and state health authorities are not fully coordinated. All those systematic conditions translate into important barriers for implementing an interoperable platform developed by the federal government.

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<sup>49</sup> Ministry of Health, "Specific Action Program 2008-2013 of the National Information System", 2008. p.26. Available at: [https://www.insp.mx/images/stories/INSP/Docs/Transparencia/150325\\_pae\\_investigacion\\_salud.pdf](https://www.insp.mx/images/stories/INSP/Docs/Transparencia/150325_pae_investigacion_salud.pdf)

<sup>50</sup> José Alfredo Ochoa Moreno, "El expediente clínico electrónico universal en México", Boletín CONAMER-OPS, Vol. 3 N. 18, 2018.p.3.

In addition, the official Mexican standard draft known as PROY-NOM-241-SSA1-2018 proposes, among other aspects, the definition of software as a medical device as one “ that does not require hardware to fulfill the intended medical purpose; it is capable of running on general computing platforms and can be used alone or in combination with other products” <sup>51</sup>. Since that draft (not approved), there has not been a clear definition on how to commercialize and design this type of software, leaving it to discretionary “ case by case” decisions of the regulatory body (COFEPRIS). In today’s era, the inclusion of software as a medical informational source has become imperative, as it provides a medium through which data can be gathered in real-time. This could help medical professionals the access to better information and implementation of disease prevention strategies in a timely and cost-efficient manner.

#### *d. OPPORTUNITIES*

Considering the particularities of the health system in Mexico (fragmentation, diversity of authorities, and lack of regulation enforcement) and the diversity of current EMR efforts, the optimal approach for a fast implementation of a Universal EMR is the creation of an interoperable platform promoted but not necessarily managed by the federal government.

Additionally, having an interoperable EMR system would allow to gather enough information to understand the overall functioning of the health system, identifying its strengths and its weakness. Also, this information could provide evidence when formulating policies to expand healthcare access in the country as well as to control the spread of diseases among the population; a useful tool specially to track in real time for example the expansion of Covid-19.

For the Universal Electronic Clinical Record to be a reality in our country, it is essential that, in addition to being established in our Constitution, to be reflected in the General Health Law, in the Regulations for the Provision of Medical Care Services and in the Official Mexican Standards mentioned above.

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<sup>51</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)



In addition, the political will of the federal government and State's health authorities is required to promote the EMR on a universal basis for all the institutions that make up the National Health System, this could be enhanced through a defined parameter under which the transition towards the Center of Intelligence on Health will be evaluated.

Just as the Ministry of Health recognizes:

The merger of public institutions will be the result of systematic collaboration and strong decision, both by the directors of the institutions and health workers to achieve a profound change in the public health system.<sup>52</sup>

Mexico has been recognized in the past by the World Health Organization, the Bank World, the United Nations Population Fund, and the United Nations Children's Fund because of its information programs on maternal mortality.<sup>53</sup> This kind of examples, and those illustrated in the national experience with EMR systems can help design a universal EMR system for the nation.

Nevertheless, the support of the government should contemplate provision of financial resources as well for this purpose.

In the next section we analyze three kinds of feasibility: economic, technical, and operative with, but not only, the results of the Evaluation and Strategies on Portability and Convergence into an Integrated National Healthcare System developed by Juan Lozano González in 2011.<sup>54</sup>

#### 4. FEASIBILITY

From local experiences reviewed in the second section and the revision of the EMR legal framework in Mexico in the fourth section it is possible to conclude that despite the existence of a regulation and the number of efforts executed, the implementation of EMR in Mexico have not been successful enough to create a single system where all health

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<sup>52</sup> Ministry of Health, "Sectorial Health Program", Ministry of Health, 2019.p.34. Available at: <https://amepresmexico.org.mx/wp-content/uploads/2019/11/191001-PROSESA-2019-2024.pdf>

<sup>53</sup> José Alfredo Ochoa Moreno, "El expediente clínico electrónico universal en México", Boletín CONAMER-OPS, Vol. 3 N. 18, 2018.p.3.

<sup>54</sup> Juan Lozano González, "Integración del Sector Salud. Situación General del Expediente Clínico Electrónico", 4a Semana Internacional de Integración del Sector Salud, México, 2011. pp.25-34.

information sources (drugstores, hospitals, patients, laboratories) can be considered to enter data.

This section analyzes some of the most important aspects that would determine the Technical, Economic and Operative feasibility of the implementation of a universal EMR in Mexico.

### **I. TECHNICAL FEASIBILITY**

This kind of feasibility refers to the resources necessary to conduct the activities and processes of the project. In this case, it involves having the necessary ICT equipment and connectivity requirements to maintain a ubiquitous EMR. The technical feasibility also involves the interoperability degree among healthcare units, and the federal and local attention levels.

In 2011, Lozano found that none of the public healthcare institutes had a 100% rate of EMR adoption, the closest to it was the IMSS with 85%, while the Federal System of Health had 13%. The national mean for registered EMR in 2011 was 44%.<sup>55</sup> In terms of infrastructure -considering connectivity, equipment, and software licenses- all institutes had high or medium capacities except for the Federal System of Health which had low capacity to adopt it.

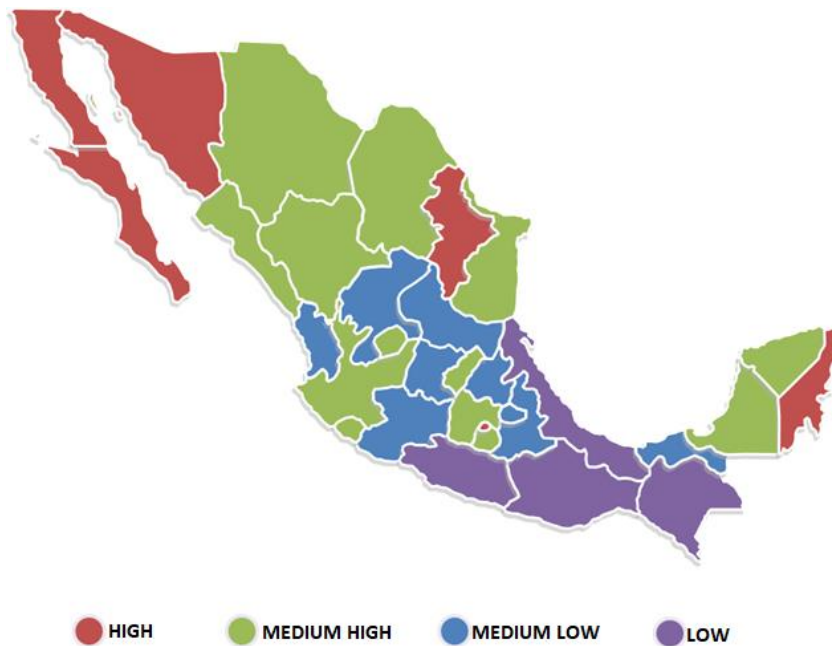
In a recent article The Social Intelligence Unit (The SIU) illustrated the status of the digital gap among the states in Mexico generating the Technological Development Index in Mexico (IDTMex) and found crucial differences between the states with biggest and states with smallest IDTMex, this can be seen in the Figure 2.<sup>56</sup> These differences in connectivity imply a challenge to implement a universal EMR system in Mexico. As it can be noticed, a regional pattern on the better and worst suited States to adopt an EMR system: the southern States have the lowest IDTMex while three northern States have the highest IDTMex.

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<sup>55</sup> Juan Lozano González, "Integración del Sector Salud. Situación General del Expediente Clínico Electrónico", 4ª Semana Internacional de Integración del Sector Salud, México, 2011. p.31. Available at: <http://www.dgjs.salud.gob.mx/descargas/pdf/4rnis-ece-01.pdf>

<sup>56</sup> The SIU, "Índice de Desarrollo TIC para México y Brecha Digital", 2020. Available at: <https://bit.ly/2Zhb3W>

**Figure 2. IDTMex level by State**



Source: The SIU, 2020.

Additionally, 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% have access to the internet<sup>57</sup>. This is clearly a barrier to patients to be able to update the information on their treatments or just to consult their EMR.

According to The CIU, 92.3% of the mobile lines correspond to a smartphone in Mexico<sup>58</sup>, and 76.3% of the population are mobile applications users. On the other hand, smartwatches reached almost 10% of the population in 8 years, suggesting that mobile technologies would represent the most universal platforms to implement a EMR solution.

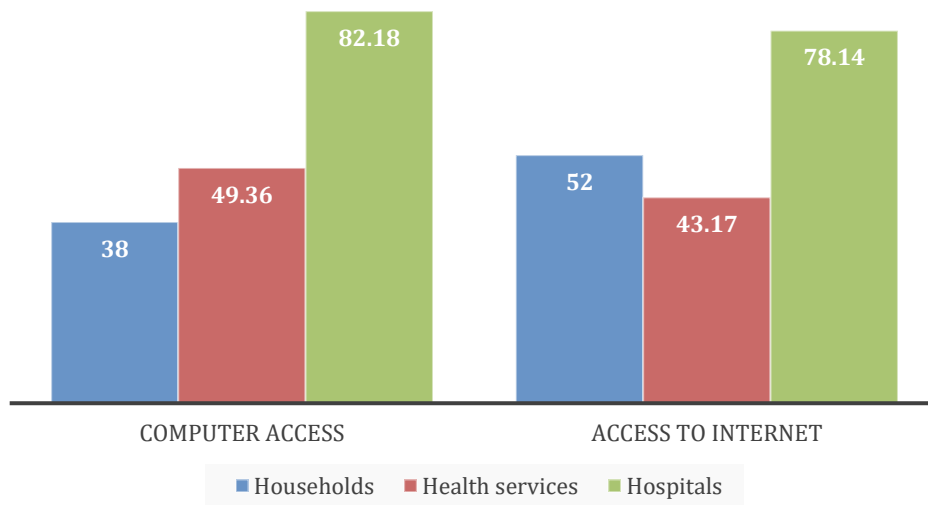
In the other hand, the results of the Economic Censuses 2019 by INEGI shows that access to internet is similar for private hospitals, laboratories, and drugstores - medical institutions that also feed the EMR -. To give an example, in the category "health services

<sup>57</sup> INEGI, "Censo de Población y Vivienda 2020", 2021. Available at: <https://www.inegi.org.mx/programas/ccpv/2020/default.html#Tabulados>

<sup>58</sup> The Competitive Intelligence Unit. "Sizing of the smartphones market: 1Q21". 2021.

and social assistance” in average 49.368% of the consulted firms have computers and only 43.17% have access to the internet.<sup>59</sup> But in hospitals do better in the survey with 82.18% and 78.14% respectively. This data, which is illustrated in Figure 3, reveals the great challenge in terms of ICT equipment and connectivity that Mexico faces to adopt a universal EMR

**Figure 3. Technical feasibility in terms of percentage of internet and computer access**



**Source:** The CIU with data from INEGI’s Census 2020 and Economic Census 2019.

The lack of ICT access (and electricity services) among healthcare providers impacts negatively on the use of EMR. The U.S. Agency for International Development (USAID) found that in the SAECOL experience, health centers used printed health records due to “infrastructural deficiencies such as sporadic lack of electricity or of computer [...] this resulted in the constant use of paper-based registers....”<sup>60</sup>

Aside from the ICT adoption, interoperability (understood as the capability of two or more systems to exchange information and take advantage of the exchanged information)

<sup>59</sup> INEGI, “Censos Económicos 2019”, 2019. Available at: <https://www.inegi.org.mx/programas/ce/2019/default.html#Tabulados>:

<sup>60</sup> Hernandez-Ávila JE, Palacio-Mejía LS, Lara-Esqueda A, et.al., Expediente Clínico Electrónico en Colima: Estudio de Caso Sobre su Implementación, Measure Evaluation, 2012.

remains a challenge. Although it is regulated in Mexico by NOM-024-SSA3-2012, local EMR experiences such as the SAECCOL in Colima is not articulated with healthcare units at federal level or other local systems.<sup>61</sup> This can be explained by the fragmentation of the system in social security institutions, public institutions for people with no social security, and private healthcare services (which increases the coordination costs for implementing interoperability), and also by the lack of general enforcement of the aforementioned regulation.

## II. *ECONOMIC FEASIBILITY*

This kind of feasibility refers to the economic and financial resources necessary to implement an EMR system. Although there are not a calculation of the overall cost of implementing a universal EMR system in Mexico, in 2015 the government of Mexico City spent around 230 million of pesos to run its Medical Information and Administration System (SAMIH) that aimed to concentrate the medical record, generated at public health institutions, in a single document and available to be consulted by all clinicians.<sup>62</sup> Nevertheless, and as it was described previously, the connectivity gap in the country suggests that this costs could be much greater in States within regions with lower technology development.

In comparison with the other country members of the OECD, Mexico is one of the countries that less expends in health as a share of its GDP, spending only 5.5% while countries like Brazil spends 9.2% and Chile 8.9%. More important is the tendency to reduce this expenditure overtime. As it can be appreciated from Figure 4, since 2010 the expenditure in health as a share of its GDP follows a downward trend complicating not only the adaptation of a universal EMR but the functioning of the health sector.<sup>63</sup>

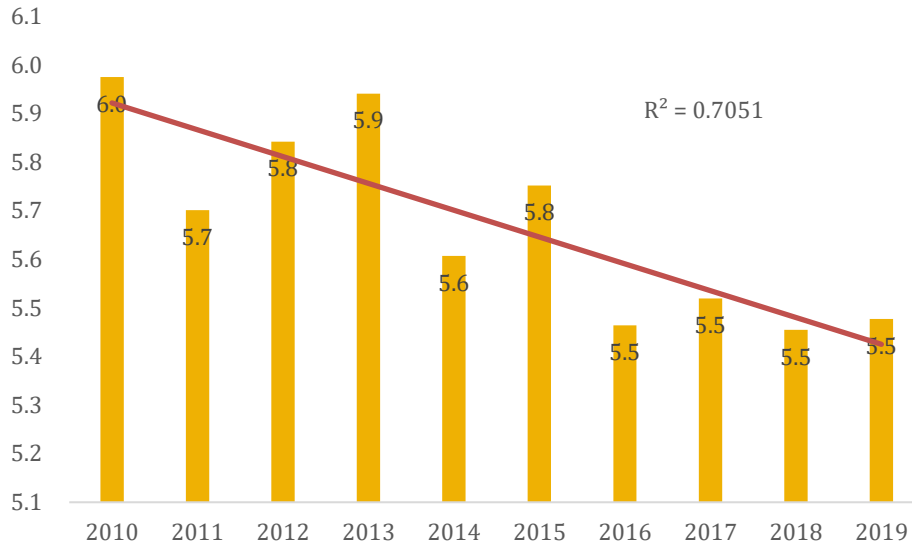
**Figure 4. Health expenditure as share of GDP from 2010-2019 in Mexico**

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<sup>61</sup> Id.

<sup>62</sup> Cintya Contreras, "Ponen en marcha expediente clínico electrónico en el DF", EXCELSIOR, January, 2015. Available at: <https://www.excelsior.com.mx/comunidad/2015/01/22/1004146>

<sup>63</sup> OECD, "Health expenditure and financing", OECD Stats. Available at: <https://stats.oecd.org/Index.aspx?DataSetCode=SHA#>



**Source:** The CIU with data from OECD.

In 2011, Lozano identified the availability of financial resources available for the development of projects, operation and maintenance, updating or improvement of current and EMR systems among public health institutions and found that IMSS, ISSSTE, PEMEX and SEMAR were the ones with highest resources available for this purpose.<sup>64</sup> Nevertheless is worth mentioning that just as Figure shows, 2011 was a year were relatively more resources were given to health institutions and so it would be reasonable to suppose that by 2020 all health institutions are reducing the resources that are destined to EMR adoption. Independently of this, the responsible and efficient management of the resources is a key element to reach the goal. That is why it is important to notice that in the Sectorial Health Program 2019-2024 commands a series of tasks to guarantee the “Transparent and honest management of the financial resources”.<sup>65</sup>

Additionally, The CIU presented an analysis on how the introduction of wearables to the Health Policy can reduce visits to clinics and therefore, save time and resources both

<sup>64</sup> Juan Lozano González, “Integración del Sector Salud. Situación General del Expediente Clínico Electrónico”, 4a Semana Internacional de Integración del Sector Salud, México, 2011.p.32. Available at: <http://www.dgjs.salud.gob.mx/descargas/pdf/4rnis-ece-01.pdf>

<sup>65</sup> Ministry of Health, “Sectorial Health Program”, Ministry of Health, 2019.p.43. Available at: <https://amepresmexico.org.mx/wp-content/uploads/2019/11/191001-PROSESA-2019-2024.pdf>

from patients and public health institutions. One of the main uses of wearables would be, as they propose, to let patients consult, update, and share their EMR with their doctors.<sup>66</sup>

Focusing on Patient Management, Chen et al. showed that wearables can be used to monitor heat stroke risk, alerting users, and therefore preventing harm.<sup>67</sup> Nguyen, N. H. et al. found that wearable technique programs have the potential to provide effective, intensive, home-based rehabilitation, which represent an opportunity to reduce hospitalization costs.<sup>68</sup> By doing this, patients will be safer if they use these devices as a method to track their health.

Physical activity lower risks of various major non-communicable diseases, while improving wellbeing and mental health at the same time. In this regard, Hafner M. et al. prove that the use of smartwatches, and proper incentives for its acquisition, promote physical activity, reducing inactivity and sedentary lifestyles. These types of exercises have been applied with the use of Apple Watches.<sup>69</sup> Furthermore, technology innovation keeps adding more tools to these devices, for example, the latest series of Apple Watch added blood oxygen measurement capabilities with an integrated health sensor, able to measure it in only 15 seconds, while periodically storing user information in the health app.<sup>70</sup>

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<sup>66</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>

<sup>67</sup> Chen, Sheng-Tao & Lin, Shin-Sung & Lan, Chein-Wu & Hsu, Hao-Yen. "Design and Development of a Wearable Device for Heat Stroke Detection", 2017. *Sensors* (Basel, Switzerland). 18. 10.3390/s18010017. Available at: [https://www.researchgate.net/publication/322024732\\_Design\\_and\\_Development\\_of\\_a\\_Wearable\\_Device\\_for\\_Heat\\_Stroke\\_Detection](https://www.researchgate.net/publication/322024732_Design_and_Development_of_a_Wearable_Device_for_Heat_Stroke_Detection)

<sup>68</sup> Nguyen NH, Hadgraft NT, Moore MM, et al. "A qualitative evaluation of breast cancer survivors' acceptance of and preferences for consumer wearable technology activity trackers". *Support Care Cancer*. 2017;25(11):3375-3384. doi:10.1007/s00520-017-3756-y. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/28540402>

<sup>69</sup> Hafner M., Pollard J., and van Stolk Christian. "Incentives and physical activity" Rand Corporation 2018. Available at: [https://www.rand.org/pubs/research\\_reports/RR2870.html](https://www.rand.org/pubs/research_reports/RR2870.html)

<sup>70</sup> CNET. "Apple Watch Series 6 now measures blood oxygen, but it's not a medical device". Available at: <https://www.cnet.com/news/apple-watch-series-6-now-measures-blood-oxygen-but-its-not-a-medical-device/>

### III. OPERATIVE FEASIBILITY

This kind of feasibility refers to human resources and their capacity to adapt and manage an EMR system. Analyzing the capabilities of each public healthcare institution in terms of human resources, Lozano grouped it in three categories: High, medium, and low. He found that IMSS, ISSSTE, Pemex, and the Ministry of Marine had high capacities while SEDENA, SESA'S, and the Federal System of Health had low capacities to adopt the EMR system.<sup>71</sup>

The Ministry of Health declared in 2019 that:

Currently, the Ministry of Health has several parallel information systems in the Undersecretaries of Integration and Development of the Health System and of Promotion and Prevention that are not interoperable. There is also a delay in access to information and the format to retrieve it is not very friendly to the public without advanced training in this area.<sup>72</sup>

Local experiences in the implementations of the EMR such as SAECCOL and SAMIH show the importance of training healthcare staff. In the case of SAECCOL in Colima, the USAID<sup>73</sup> recognized that training Medicine students in the use of the EMR is optimal since healthcare centers lack of enough IT staff for training clinicians, and in some rural healthcare centers the medical staff is mostly integrated by Medicine students. Recently, the government of Mexico City recognized the relevance of training medical staff, they reported that in the use of SAMIH, between August 2020 and July 2021, 580 physicians, 415 nurses, 371 administrators and ninety-seven people considered clinical staff were trained.

In the technical feasibility section, it was mentioned the considerable level of access of mobile technology (smartphones, mobile applications and the faster increase on smartwatches use) in Mexico, suggesting that these devices and software might represent the optimal access to a EMR system.

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<sup>71</sup> Ibid. Ministry of Health, p.31.

<sup>72</sup> Ibid. Ministry of Health, p.34.

<sup>73</sup> Op cit. Hernandez-Ávila JE, Palacio-Mejia LS, Lara-Esqueda A, et.al.



As stated before, the EMR is not contemplated in the General Health Law, which makes application difficult, it is possible to generate medical records, but they are not portable by the data management regulations due to the lack of interoperability and integration across systems.

Analyzing it by states, Aguascalientes, and the State of Mexico report 5 EMR systems, making them the states that use more systems, followed by Baja California and Sonora with four. After them Guanajuato, Nuevo Leon, and Puebla make use of three. Finally, Baja California Sur, Campeche, Colima, Hidalgo, Morelos, Nayarit, San Luis Potosí, Tlaxcala, and Yucatán report, each, the use of a single EMR system within their services.

The system most reported is the Information System for Hospital Management (SIGHO), in use by nine states: Baja California, Baja California Sur, Guanajuato, Guerrero, Hidalgo, Nayarit, Sinaloa, Sonora, and Zacatecas. However, more than ten versions of SIGHO are used in these states.

The diversity of EMR systems used within Mexico adds challenges to the objective of generating a universal EMR system in the country. While some states have solid experience with their EMR systems, others have never even tried to add one. Even if states can benefit from the exchange of experiences, while there is not a mandatory policy to include EMR in all health institutions in the country, the lack of local political will represents the main obstacle in the journey to a ubiquitous healthcare system.

## 5. FINAL REMARKS

As technology evolves, the health sector has the potential to include EMR innovations to improve research and development of treatments, e-Health, medical procedures, and gathering of medical information. Additionally, the complementary use of smartphones and wearables technology with EMR can relief costs linked with visits to hospitals that can be reduced if consulting and updating the EMR with these devices could be possible.

A diversity of international examples supports this and show that advantages from EMR's implementation involve creating a culture of quality in healthcare, mainly because its methods and the information it gives can be used to thrive education, research, treatments, and evaluation of medical practices.

Additionally, the digital collection and safe storage of medical data empower Mexico's healthcare industry to not only reach more patients, but to also provide a powerful tool to reverse the trend of chronic illnesses such as diabetes and obesity.

Although there is a clear legal framework that states requirements and how an EMR should be, it is essential that, in addition of being established in our Constitution the right to receive quality health services, to be reflected in the General Health Law the necessity of an interoperable platform that reunites all EMR systems for all healthcare institutions as well as to promote the use of smartphones and wearables to monitor and feed health records.

Surveillance of the current NOM-024-SSA3-2012 should be enforced thus, the Center of Intelligence on Health, as proposed in the Sectorial Health Program 2019-2024, will be able to gather, protect, and analyze health data that comes from a diversity of agents (from hospitals to drugstores, and patients themselves).

Nevertheless, there are challenges to overcome, as stated in the Feasibility section, the technology development gap among States, the lack of experience in EMR's adoption, and the reduced budget of the healthcare sector, among others.

To address some of the challenges of the EMR implementation, it is relevant to explore other innovations such as the blockchain which can support interoperability, auditability

and privacy of patients' data while enables "collaborative clinical decision-making" and provides the patient with full control of their health information.<sup>74</sup>

Some recommendations are provided to enhance public policies on reducing the digital gap, especially in the States with low IDTMex – in the south of the country-, since this can benefit policies on implementing an EMR system. More importantly, it is necessary to reformulate/update the General Health Law to reflect the need of a universal EMR, as well as to be a driver on National Health Budget to improve health service in Mexico.

Summarizing the recommendations to implement an EMR system in Mexico are:

- Develop healthcare public policies which contemplate and promote the adoption of EMR in all, public and private, health institutions across the country, and adoption of ICT devices such as smartphones and wearables to access and feed the system.
- Promote an interoperable platform that allows the integration of information from existing and future EMR.
- Promote mobile devices and software such as Smartphones, and mobile applications, as well as wearables, as the pivotal technologies for a universal EMR policy; given de high penetration level of mobile devices in Mexico.
- Develop a training model for health-related students and clinicians on the use of EMR.
- Procure the enforcement of regulation regarding interoperability of EMR systems.
- Include the concept of a universal EMR in the General Health Law, as well as the adoption of ICT devices such as smartphones and wearables to easily access and feed the system by patients.
- Update the current legal framework (NOM-035-SSA3-2012) to ensure the easy and secure access to their medical data by patients though interoperable digital technologies such as smartphones and wearables

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<sup>74</sup> Mayer, André & André da Costa, Cristiano & Righi, Rodrigo. (2019). "Electronic health records in a Blockchain: A systematic review". Health Informatics Journal. 26. 146045821986635. 10.1177/1460458219866350.

- Adjust the NOM-024-SSA3-2012 to be compatible with international experience such as the 2016 21st Century Cures Act (United States), particularly the ONC Cures Act Final Rule which recently went into effect. This rule "...is designed to give patients and their healthcare providers secure access to health information. It also aims to increase innovation and competition by fostering an ecosystem of new applications to provide patients with more choices in their healthcare".
- Promote within the NOM-024-SSA3-2012 mechanisms that allow the incorporation of health information from devices such as wearables.
- Promote pilot programs of universal EMR between private and public health providers.
- Build up an EMR system linked with technologies such as wearables, blockchain, and mobile technologies.
- Advocate for a connectivity policy complementary to health policy to expand EMR access, specifically in the southern states of the country.
- Promote connectivity in public healthcare centers through existing mechanisms such as the Red Compartida. According with information of the Ministry of Communications and Transportation (SCT by its acronym in Spanish) and the Energy Federal Commission (CFE by its acronym in Spanish), it is possible to estimate around 11,000 healthcare public sites with connectivity requirements.

## 6. APPENDIX

### I. *ADDITIONAL INTERNATIONAL EXPERIENCES ON EMR SYSTEM IMPLEMENTATION*

#### **Peru**

In Peru APP projects are also taking place, with four of them currently pursuing e-Health strategies. Two Social Security Hospitals, Guillermo Kaelin and Alberto Barton have implemented an interoperable EMR system. Furthermore, Lima's Social Security Network has built an Integrated Informational System for logistics management of medication and supplies, which gathers data from both private and public organizations, and has the potential of integrating cloud-computing, artificial intelligence, and remote tracking capabilities.<sup>75</sup> This system provides efficient allocation and deployment of assets for the public health sector, as well as better management and operation, while boosting service quality provided.

#### **Canada**

In 2006, in the province of Alberta, Canada, the Public Electronic Health Registry (Netcare) was created, which allows authorized doctors to access the medical records of patients in the region. In the same way, patients can access their information at any time through a digital portal.<sup>76</sup>

#### **Holland/Netherlands**

In 2005, the Dutch Ministry of Health embarked on a journey to implement a National Electronic Health Registry for all citizens. Its objective was to improve the effectiveness and quality of care through the optimal use of Information and communications technology (ICT). Although Dutch efforts may not often be cited in international contexts, progress in recent years has been impressive.

In the Netherlands, there is currently an exchange of patient data through a central organization, the *Landelijk Schakelpunt*. It is a system that is based on the National Electronic Health Registry that was introduced in 2008. This system is administered by

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<sup>75</sup> SALOG, "ESSALUD APP", 2021 Available at: <http://www.salog.com.pe/nosotros/>

<sup>76</sup> Government of Alberta, "Welcome to Alberta Netcare", Government of Alberta, 2020. Available at: <https://www.albertanetcare.ca/>

VZVZ, a specialized communication organization consisting of twenty parts of the healthcare sector.

At least 80% of people with chronic illnesses should have access to their own medical records by 2019, and at least 40% of other members of the population. By 2019, 75% of people with chronic illnesses and vulnerable older people can monitor certain aspects of their own health and share the data with their healthcare provider. This includes blood pressure and cholesterol levels.<sup>77</sup>

### **Sweden**

The role of the central government, which includes the Swedish Electronic Health Agency, establishes principles and guidelines, setting the political agenda for health and well-being at the national level. Swedish health system is tax-funded and decentralized, meaning that twenty county councils (regions) finance almost all medical care and provide most of the services. Sweden has reimbursement systems to pay private health service providers with public financing.

In the context described, the Swedish Electronic Health Agency plays a significant role as it stores and distributes all electronic medical prescriptions. It also manages and develops a range of different electronic health services, such as the National Drug List. This makes an important contribution to the promotion and coordination of digital health projects.<sup>78</sup>

### **United Arab Emirates**

Public and private hospitals in Abu Dhabi will share medical records for the first time to reduce costs, prescription errors, and repeat testing. The unified database will link the complete medical data of hundreds of thousands of residents and citizens giving all doctors access to hospital visit and laboratory test data from any health facility.

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<sup>77</sup> Government of the Netherlands, "Government encouraging use of eHealth", Government of the Netherlands, 2020. Available at: <https://www.government.nl/topics/ehealth/government-encouraging-use-of-ehealth>

<sup>78</sup> Government Offices of Sweden, "Swedish eHealth Agency (eHälsomyndigheten)", Government of Sweden, 2020. Available at: <https://www.government.se/government-agencies/swedish-ehealth-agency-ehalsomyndigheten/>

The health information exchange system will be introduced for four years. Nowadays, doctors rely on patients' honesty about pre-existing conditions and test results. It will allow physicians to make better informed decisions and increase the quality of service, while maintaining confidentiality.

The secure system will be developed under Injazat Data Systems, a Mubadala subsidiary, and will be implemented in three phases until 2022.<sup>79</sup>

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<sup>79</sup> Shireena Al Nowais, "Unified medical record database coming to Abu Dhabi", The National, 12 august 2018. Available at: <https://www.thenational.ae/uae/health/unified-medical-record-database-coming-to-abu-dhabi-1.759275>

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