Article **Journal-Economic History**
June, 2022 Vol.6 No.10 27-37

Adoption of the electronic medical record in Mexico: a review of the status

Adopción del expediente clínico electrónico en México: revisión del estado actual

RAMOS-GONZÁLEZ, Javier†

ID 1st Author: *Javier, Ramos-González*

Universidad Iberoamericana, México.

DOI: 10.35429/JEH.2022.10.6.27.37 Received January 20, 2022; Accepted June 30, 2022

Abstract

I present a brief review of the actual status in the adoption of Electronic Health Record in Mexico. I reviewed investigation articles and official information from the main health institutions and federal regulation. I describe the experience of the main health institutions and the structure of the regulation, remarking the lack of specific definitions and a clear nationwide strategy to allow the focus of the different efforts. I present also a new public and private partnership (PPP) focus for the investment on new health institutions that is currently the most solid effort in the adoption of the EHR as an integrated system.

Electronic health record, Health, PPP

Resumen

Presento una breve revisión del estado actual en la adopción del Expediente Clínico Electrónico en México. Revisé artículos de investigación e información oficial de las principales instituciones de salud y de la regulación federal. Describo la experiencia de las principales instituciones de salud y la estructura de la regulación, destacando la falta de definiciones específicas y de una estrategia clara a nivel nacional que permita focalizar los diferentes esfuerzos. Presento también un nuevo enfoque de asociación público-privada (APP) para la inversión en nuevas instituciones de salud que es actualmente el esfuerzo más sólido en la adopción de la HCE como un sistema integrado.

Expediente clínico electrónico, Salud, APP

Citation: RAMOS-GONZÁLEZ, Javier. Adoption of the electronic medical record in Mexico: a review of the status. Journal-Economic History. 2022. 6-10:27-37.

† Researcher contributing as first author.

Introduction

This document aims to provide a brief review of the current status of the implementation of the Electronic Health Record in Mexico, using information from various research articles and official information.

From various research articles and official information, a brief outline of the main benefits, the existing experience in the main Mexican health the main benefits, the existing experience in the main health institutions in the country and the existing the existing regulation for the use of the electronic health record and the requirement for interoperability.
interoperability requirement.

Definition of HER

An electronic health record (EHR) is the electronic collection of information concerning the health status of a patient or patient's the health status of a patient or population. Currently an ECE brings together information of information from different domains of the patient, including clinical, administrative, demographic, medical history demographic, medical history, allergies, medication, test results and patient account.

Patient's account

The ECE is designed to accurately report the patient's current status at all times, allowing it to be consulted and updated by different medical personnel requiring access, which helps to keep it up to date from different points of view of patient care. The ECE resource is conceived as an interoperable tool that can integrate medical information from other systems such as interpreted clinical imaging results, laboratory studies or real-time information on the patient's vital signs.

An ECE is organised through modules that allow different functionalities of operation, control and registration of clinical activity for the patient. In Mexico, the NOM-024-SSA3-2012 -Electronic Health Record Information Systems‖ is used, which establishes the main functionalities of the ECE.

Pillars and Modules of an ECE:

Medical Care: Focused on clinical records made during the interaction with the patient.

Administration and Results Ordering: Management of requests for medicines, studies and diagnostic aids, as well as the corresponding flow of verification, request and delivery of results in real time.

Administrative Management: Management of consents, support for the communication of clinical documents.

Clinical Management: Management of patient history, list of allergies, adverse reactions, current medication, inclusion of external clinical information.

Health Prevention: Management of preventive care campaigns and alerts.

Public Health: Management of public health notifications.

Decision Support: Inclusion of clinical practice guidelines, protocols, supporting documents. Management of referral information and pattern identification.

Technological Infrastructure: Focus on standard information management with adequate levels of security to allow information exchange between different departments.

Medical Informatics and Terminology Standards: Inclusion of internationally accepted standard terminology such as LOINC, ICD-9 and ICD-10.

Interoperability Platform: Inclusion of standards for information exchange such as HL7.

Security: Handling of authentication and electronic identification through profiles, control of access to information according to profile, logging of audit trails, interoperability with state information systems.

Decision Support: Focused on the registration and control of information that improves decision-making processes at different levels.

ISSN 2524-2059

Clinical Management: Patient registration, management of mandatory biostatistics reporting.

Administrative Management: Clinical staff directory, organisation of human and material resources for emergencies.

Public Health: Reporting, monitoring and analysis of statistics.

Benefits

The benefits that are generally associated with an ECE have been widely discussed in different countries and studies, just as an ECE encompasses all areas of a hospital that relate to patient care and the benefits comprise a wide variety of situations, in general we can cite benefits from the following points of view:

- Improved quality of patient care

The most controversial so far is the improvement of quality in patient care, given that quality in the context of health care is understood as the recovery of health with the lowest possible risk of complications with the best cost-benefit ratio and the highest patient satisfaction [1], it is very complicated to evaluate it and subsequently link the results of the study to the correct use of an ECE that has the minimum necessary modules to allow the development of the medical practice related to the study. On the same subject, there have been efforts to measure quality based on a specific treatment, where quality measurement indicators have been defined and obtained through the use of the electronic clinical record, where the information was not totally reliable, but the result was congruent with the current situation in the country. [2]

- Improving waiting times for care

In the area of time improvement, the mechanics of the initial introduction of an ECE, as with any system, implies a learning curve that will cause an increase in time and effort, mainly on the part of clinical staff [3].

- Better control of supplies in health care

Thanks to the introduction of electronic prescribing and inventory control as unidosis, ECE allows a detailed record throughout the entire supply process until delivery to the patient, thus allowing tracking of any problems and reducing overuse of medicines.

- Reduced study turnaround times

Given the premise of interoperability, the ECE integrates with other systems surrounding patient care, such as vital sign monitors, imaging studies and laboratory studies. By integrating through an ECE, the request and delivery of results is done through the ECE, allowing the results of studies to reach the appropriate clinical staff immediately. In the case of imaging, it is possible to define whether the images should be available for consultation from the moment they are taken or until they are interpreted by a technician. It should be noted that this process avoids printing images, as the entire cycle is handled digitally.

- Improving hospital processes by centralising the functionality in the file

Similar to the studies, the ECE is responsible for grouping all the care around the patient, presenting a single view for all clinical staff involved and thus avoiding loss of information or duplication. The ECE allows all staff to have up-to-date information and to be aware of the patient's current status, as well as their studies, medications, history, surgical schedules, etc. This allows the care to have a continuous flow through different departments.

- Time reduction in the collection of hospital statistics

As defined by NOM-024 in its decision support section and public safety chapter, it has all the clinical and administrative information that allows the integration of statistical reports.

From the key operation of a hospital to epidemiological surveillance, they are of course two very different sides of the same functionality, so there must be different people in charge, but the ECE has the capacity to integrate the information of all patients and their care process.

- Availability of clinical records between different institutions through interoperability

At the regional and national level this is the greatest benefit associated with an EHR, as it has implications for the health care process that support universal health coverage and are of particular interest to the federal health ministry. On this issue, many countries have tried to generate a national scheme that allows patients to be seen in any hospital without the need to lose all their medical records, but this is the most complicated goal, as countries with a high degree of technological integration, such as the USA, which started its ECE process in 2004, have a high degree of technological integration. which began its EHR migration process in 2004, estimates that it will take until 2024 to consolidate a nationally interoperable health system [3]. As another example, Canada began a similar effort in 2001 by promoting national funding and policies for the establishment of a nationally interoperable EHR structure, but by 2011 only 36% of physicians were using a medical record, lagging behind the US, which had begun three years later [4].

- Reducing costs by eliminating complexity and duplication

As with all system implementations, the adoption of an ECE involves rethinking the way some of the most important processes work in a hospital, both clinical and administrative, and represents a valuable opportunity to improve processes by simplifying them through the use of ECE. In addition to process simplification, an ECE that has integrated patient safety issues such as referrals to care protocols, contraindication alerts

In addition to process simplification, an EHR that has integrated patient safety with topics such as referrals to care protocols, contraindication alerts and drug reactions can lead to cost reductions in patient care.

This benefit turns out to be one of the most expected and complicated to obtain, as a study of the total cost of ownership for each system is necessary, taking into account that not all hospitals have the infrastructure and specialised personnel to maintain an ECE.

Eastaugh comments that in the US, productivity improvements are typically expected to be seen within 2 years of implementation and cost savings up to the point of return on investment between 5 and 7 years after implementation [5].

- Improved patient safety

As mentioned in previous points, an ECE is involved in the whole cycle of patient interaction, and for this reason it can include functionality to ensure that patient safety is taken care of, a basic topic covered is patient identification, an ECE can rely on barcode scanning of patient wristbands to meet this objective but there is also much more complex functionality such as identification of contraindications to medications prescribed by a physician and modules to document adverse events, reminders for medication intake and inclusion of instructions for special care and studies. [5]

In Mexico, as we can see in the definition of modules according to the SSA, results are sought in several of the expected benefits of an ECE, in a quick analysis we can associate the chapters with the expected benefits for each one:

Medical care: improvement of quality, better control of inputs, reduction of times.

Technological infrastructure: Availability of the file through interoperability, reduction of time in the delivery of studies.

Decision support: Improved time and quality of hospital statistics, improved processes.

Apart from the benefits reported in the integration of information and improvement of processes, there are studies that link the quality of care through the adequate follow-up of the defined processes and the quality in the filling out of the documents present in the Hospital, and it is here where the definition of an ECE as a tool for the integral control of processes and quality gains great strength. In a study of 18 hospitals in Guadalajara, it was found that the lack of standardisation of processes and the presence of a deficient information system was identified in 22% of cases as inhibiting quality, as well as deficient completion of clinical records in 33% of cases [6].

Regulation

As mentioned above, the applicable regulation in Mexico is NOM-024-SSA3-2012, which is mandatory; the structure of the standard defines that separate guidelines and formats for health information exchange will be created. Previously, NOM-024-SSA3-2010 defined sections, chapters and indexes where each index describes the minimum functionalities that an ECE must comply with; it also contained a normative appendix with standard information catalogues, which are the minimum fields that must be collected in an ECE for each type of object.

For the 2012 update, all the expected functionality definitions were removed and this task was directed to the guidelines and formats that would later be defined by the DGIS.

NOM-024 seeks to standardise the structure of an ECE to ease the way for interoperability between different institutions.

To interoperability between different institutions while at the same time seeking to cover key cover key functionality and bring existing systems closer to different government programmes.

Below is a table showing the structure of NOM-024-SSA3-2010

Section	Chapter	Index	Functional
Normative appendix B	Catalogs	B	Catalogs
	Objects	A	Fields
Medical care Technological infrastructure	Management of orders and results	1.1	Administration of orders and medications
			Referral and results management
			Management of requests, referrals and results for diagnostic or treatment support units
			Administer patient medication management
			Manage diagnostic and treatment profiles.
			Generate requests for patient care
			Request for blood and blood products
			Request for diagnostic aids
	Administrative management	1.2	Consents and authorizations
			Clinical workflow of case management
			Clinical communication support
	Clinical management	1.3	Management of a patient's patient demographics
			Medication list management
			Manage allergy and adverse reaction lists
			Manage problem lists
			Manage summary lists
			Capture, manage and review clinical information
			Record external clinical documents.
			Recording, updating and managing patient medical records.
	Health prevention	1.4	Notifications and reminders of preventive and wellness services.
			Provide alerts for preventive and preventive and wellness services.
			Health care support: preventive care and wellness.
	Public health	1.5	Notification and response support
			Public health support
			Support for monitoring and response tracking of individual patient health notifications
	Decision support	1.6	Manage clinical information to facilitate decision decision support
			Generate and store patient-specific instructions.
			Orders, referrals, results and care management
			Health care plans, clinical guidelines guidelines and protocols
			Care plans, clinical guidelines and protocols Knowledge access support

			Support of standardized clinical assessments support
			Support for identification of potential problems and patterns
			Support in the administration of medications and immunizations
			Support for patient assessments patient assessments in a variety of contexts
	Medical informatics and terminology standards	3.1	Medical informatics and terminology terminology
			Health informatics maintenance maintenance
			Mapping of local terminologies, codes and formats
	Interoperability interoperability platform	3.2	Information exchange standards information exchange standards
			Interoperability based on standards
	Security	3.3	Authentication
			Entity authorization
			Confidentiality and patient privacy patient
			Consultation of information in the electronic medical record information
			Access control Secure data exchange
			Interoperability of State, National and State, National and Institutional
			Audit trails
			Ratification of information
			Secure Routing of Information Between authorized entities
			Synchronization
Decision support	Administrative management	2.2	Health personnel directory
			Availability of health resources availability of material and human material and human resources for emergency emergency situations
			Maintenance of decision decision support functions
	Clinical management	2.2	Patient directory Health care episodes
			Notification to national registries and special mandatory reporting registries
			Patient relationship with family members and contacts
	Public health	2.3	Report generation
			Measurements, monitoring and analysis

Table 1 NOM024-SSA3-2010

There are still many problems regarding the use of the ECE in Mexico, this norm represents the first step towards the standardization of the information and modules managed in an ECE, however, it still lacks the necessary guides and formats to establish a specific frame of reference.

According to the NOM in its index 6.1.4 specifies that ―The Guides and Formats specify the details of the exchange of information between Health Service Providers [7] in its index 6.1.5 establishes the DGIS as responsible for its development ―The elaboration and updating of the Guides and Formats is coordinated by the Secretariat in its capacity as coordinator of the SNS, through the DGIS, through of the procedure published by the Secretariat for this purpose" [7] however, when reviewing the DGIS page, only two guides have been published [8]:

Reference Architecture: In this document, the DGIS refers to the most used standards in the industry regarding interoperability and communication profiles between health information systems, so it does not specify a standard architecture customized to the operation of the country's institutions, leaving the system architecture to be used at the discretion of each institution and therefore does not establish a minimum framework that supports interoperability. The document quotes in its statements:

The information, diagrams, bibliography and other references contained in this document are the property of their respective owners. This document is only a reference to each one of them, to have access and to be able to make use of them, the provisions, guidelines, costs and/or procedures for their acquisition must be observed directly with their authors. [9]

Guides and formats for the exchange of health information for a health ISMS: In this document, the DGIS refers to a reference framework for the implementation of an information security management system based on ISO 27799, which takes the ISO/ IEC 27002. [10]

As we can see, the first steps have been taken to regulate and organize the use of the ECE at the national level, however the policies do not have an appropriate level of specificity to guide an adequate development of processes for interoperability, they have simply been identified and named. the most widely used international standards for the definition of processes and exchange of information in health matters.

Unfortunately, a setback is identified, in the 2010 publication there was an identification of the minimum modules required for an ECE while in the update to 2012 this task was delegated to the guides and formats that would be developed later, even though they do not exist and only appear from a list of various international reference frameworks that can lead to different implementations, not necessarily interoperable. In the 2010 standard, despite the categorization of the standard functionality, the characteristics that this functionality represents were not detailed enough, for example in the medical care section, order management chapter and index results.

Management functionality of orders and medications established the following:

a) It must allow the selection of medicines from a catalog.

b) Must show the list of medications prescribed to the patient.

c) It must allow the capture of medications reported in any other prescription on the existing list.

d) You must ensure the complete completion of the fields referring to the general instructions, name of the medication to be prescribed, dose, route of administration and duration of treatment.

e) It must show inactive and/or solved problems.

f) It must allow the linking of drug orders, with the drug inventory of the pharmacy for its supply.

g) It is recommended to alert the doctor when filling out the medication request if the medical insurance does not cover or partially covers the indicated medical treatment.

- There is no definition of alerts for intake, identification of conflicts or interactions with previously ordered medications, or inclusion of special instructions for intake.

- In the next section I will name some examples of efforts in the use of ECE that have been carried out in different institutions, where we can clearly see how coordination work is needed at the federal level, understanding by this a national digital strategy that defines the direction for that all dependencies work towards the same goal.

Current Implementations

Efforts in the field of ICTs referring to the use of ECE in different dependencies have already come a long way, however previous efforts are perceived as isolated depending on each institution and it is until the past six-year term and the current one that a second wind of momentum begins. to the implementation of ECE in the main institutions of the country.

ISSN 2524-2059

For analysis purposes we will consider the following public institutions:

IMSS: Mexican Social Security Institute

ISSSTE: Institute of Security and Social Services for State Workers

PEMEX: Petróleos Mexicanos

SSA: Ministry of Health

For each one we will break down the efforts that have been carried out for the implementation or at least the structuring to implement an ECE.

Health Secretary

He takes the first steps in creating national systems for epidemiological surveillance records in 1995 and subsequent evolutions [11]:

National Epidemiological Surveillance System (SINAVE)

Single Information System for Epidemiological Surveillance (SUIVE)

Unique Automated Epidemiological Surveillance System (SUAVE)

Later, in the creation of Seguro Popular, it sought to include the use of technology through different efforts [11]:

2001 – 2005 TUSALUD Card: Card used to register personnel enrolled in popular insurance through a single method. Both beneficiaries and affiliated pharmacies were registered for the sale of medicines.

2000 – 2006 Hospital Administration System (SAHO): Focused on the use of free software and the development of SAHO began, four main modules were defined: medical services, administrative services, catalog management, and medical agenda management. About 20 Hospitals used the first version of this system.

2007 Official Mexican Standard: The Ministry of Health begins the development of the standard to control the ECE considering aspects of interoperability, processing, interpretation and information security. It was planned to generate an interoperability model between 2007 and 2012.

ISSSTE

Being part of the main health institutions in Mexico, it was also one of the pioneers in the development of ECE through the following efforts:

1991 Integral Medical Information System: Concentrates statistical information on hospital care.

1975 Automated Detection and Diagnosis Clinic: Registration of clinical history in the system.

1995 Hospital 20 de Noviembre: Adopted the Hospital Information System (SIAH) text-based interface, with different modules for clinical history, medication management, pharmacy, laboratory, social work, statistics and continuous admission and outpatient flows.

IMSS

It is the main health institution in Mexico with more than 16 million affiliates.

Efforts in the use of ECE are as follows [12]:

2002 Sistema de Medicina Familiar (SIMF): specialised in first level medical care, including laboratory, imaging and administrative staff. [11]

2004 The outpatient module was integrated into the SIMF, as well as statistical reports for the Integrated Health Care Information System (SIAIS).

2004 Implementation of the Hospital Outpatient Information System (SICEH) began for second and third level units as well as IMSS Vista for hospital control.

2006 SIMF covers over 90% of first level units with sustained use from 2007 onwards.

Modules developed:

- Diary management.
- Clinical history.
- Diagnosis and treatment aids.
- Electronic prescription.
- Referral and counter-referral.
- PrevenIMSS.
- Social work.
- Hospitalisation.
- Emergency room.
- Operating theatre.
- Nursing.
- Pathological Anatomy.

International integration standards such as HL7 and DICOM are used.

- 2006 Creation of a Digital Hospital with the best technology available at the time through partnerships with different technology institutions (Intel, Awarix, Deloitte, Cisco, HP, Microsoft and Phillips) integrating 17 additional systems to SICEH, SIMF and IMSS Vista to include pharmacy, nutrition, collaboration, real-time location, drug monitoring and telemedicine modules.

PEMEX

It is the third largest health institution in the country, and is responsible only for covering services for its own employees and their families. It has the following systems:

Institutional Pharmacy Administration System (SIAF): Started in 2003.

Institutional System of Hospital Administration (SIAH): Manages the administrative control in the integration of the patient's account as well as the integration of Diagnostic and Therapeutic Guides.

Progression of improvements:

- 1997 Appointment control
- 2001 Clinical Note
- 2003 Electronic Prescription
- 2004 Laboratory, Hospitalisation and Information Kiosks
- 2005 Operating theatres
- 2006 Imaging and clinical practice guidelines
- 2007 Universal Record
- 2010 Personal card via the internet and epidemiological surveillance module
- 2011 Digital and web-based imaging

Public-Private Partnership Model

Since the last six years, PPP schemes have gained momentum for initiatives in the construction and replacement of hospitals. Under this scheme, attempts have been made to replicate the example of the "Digital Hospital" developed by the IMSS with different results, although as previously reviewed, between 5 and 7 years must pass to observe the most consistent and mature results in the implementation of a PPP, in the case of a public-private partnership model it is likely to be at least 7 years since under this scheme the following characteristics are present:

- The institution applying for a Hospital in PPP model requests services, equipment, systems and construction or demolition.
- Concessions are for 20 to 25 years.

The investor, provider or developer creates a specific purpose partnership to:

- Design and build the new hospital based on the requirements of the institution, in some cases the design is already
- Design and build the new hospital based on the institution's requirements, in some cases the design already exists.

- Operate the requested services in the hospital. They usually request between 18 and 25.
- Equip the hospital based on the institution's requirements.
- Provide and integrate the systems that cover the needs:
- ECE
- Laboratory Systems (LIS)
- Imaging Systems (RISPACS)
- Diagnostic and Treatment Assistants
- Administrative (ERP)

As IMSS did with the -Digital Hospital‖ model, the idea of PPPs is to integrate state-of-the-art systems and equipment in a Hospital that works in an integrated manner to provide the best possible services, however, it is precisely in these schemes where the lack of guidance from the authorities for interoperability is evident.

Hospitals built and operated under the PPP scheme include the following [13].

Conclusion

The adoption of ECE in Mexico is still at an early stage, although there are different initiatives in the main health institutions in the country, the efforts are not coordinated by a federal level agency, and at the same time no standard operating model and generally applicable business rules have been created that would be applicable to all hospitals in the country.

Interoperability of the various ECEs under development. In the absence of a federal strategy, Mexico still lacks a direction to unite the incipient systems towards a consolidation of a universal dossier.

On the other hand, the various efforts have concentrated on free software and internal developments that have been in charge of solving operational problems without seeking the creation of intelligent systems capable of supporting medical decisions as well as the creation of integrated systems that involve extensive connections to the different specific information systems commonly present in a hospital (imaging, laboratory, nutrition, vital signs, etc.).

In the same way, the public-private partnership scheme for the creation of digital hospitals with high technological integration represents the closest effort to the definition of integral operation models that allow the use and development of ECE with high interoperability, however, so far there are no examples of information exchange between different PPP hospitals.

References

1. J. M. M. Hector Robledo Galvan, "De la idea al conceptoen la calidad en los servicios de salud," Revista CONAMED, vol. 17, no. 4, pp. 172-175, 2012.
2. e. a. Ricardo Pérez Cuevas, "Evaluating qualitiy of care for patients with type 2 diabetes using electronic health record information in Mexico," BMC. Medical Informatics and Decision Making, 2012.
3. T. Francis, "Electronic Health Records: Where we are and where we are going," Physician Executive, pp. 82-84, August 2013.
4. R. Rozemblum and Y. Jang, "A qualitative study of Canada's experience with the implementation of electronic health information technology," Canadian Medical Association Journal, pp. E281-E288, 22. March 2011.
5. S. R. Eastaugh, "Electronic Health Records Lifecycle Cost," Journal of Healthcare Finance, pp. 36-43, 2013.
6. A. M. Ramirez, "Factores Inhibidores de la Calidad en los Servicios de Salud.Análisis desde la perspectiva de los Hospitales privados y públicos.," Revista CONAMED, vol. 14, no. 4, pp. 5-14, Octubre 2009.

7. SSA, "NOM-024-SSA3-2012 Sistemas de Información de registro electrónico para la salud. Intercambio de información en salud," Diario Oficial de la Federación, pp. 79-96, 2012. LOS TIEMPOS (9 de abril del 2000). pp.C1.