Electronic Health Record Systems

Definitions, Evidence, and Practical Recommendations for Latin America and the Caribbean

IDB

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Content

Executive Summary

Electronic health record (EHR) systems are increasingly considered to be one of the most relevant information technology tools for strengthening health systems in Latin America and the Caribbean (LAC). Despite this interest, few LAC countries have adopted EHR systems at scale. This document uses the available evidence to provide policy makers and other stakeholders with general insights about EHR systems. The first section summarizes the potential and promise of EHR systems for LAC, the second section reviews definitions of EHR systems and their key functionalities, the third section provides an overview of the impacts of EHR systems based on the existing evidence, the fourth section describes the key challenges related to implementing EHR systems, and the fifth section proposes practical recommendations to support successful implementations of EHR systems at scale in LAC.

Key Takeaways

- Terms and definitions for Electronic Medical Records (EMRs), EHRs, EHR systems, and EHR Architecture (EHRA) can be complex and confusing. It is important for countries to clearly define every term they use and understand the functionality implied by a term—particularly when comparing between software solutions or evaluating evidence on the types of software solutions while deciding which one to implement.

- Although the International Organization for Standardization (ISO) has issued guidance on these terms in English, upon analyzing definitions used in the Americas, both Spanish and English-speaking countries use different terminology and definitions. It is important to review international definitions and agree on a common term, definition and core functionalities in Spanish to create a common set of expectations about EHR system capabilities in LAC and to differentiate between the various types of EHR systems or their minimum content or functionality.

- It is also important to understand definitions used when reviewing evidence. Evidence suggests that, when correctly

implemented, EHR systems improve the completeness, security, and real-time access of information and the quality and efficiency of care. Specific functionalities of EHR systems have been documented to improve health outcomes and yield a positive return on investment. However, some negative effects have also been documented, particularly in terms of disruptive changes in workflows and workloads that affect productivity, which can lead to burnout in physicians and increase the time spent on computers.

- The main types of challenges identified in the literature related to EHR system implementation were financial and technical (e.g., lack of infrastructure, such as equipment and connectivity, and standards for interoperability). However, a successful EHR system implementation also depends on people. A common mistake among EHR system implementers is underestimating human-related challenges to system adoption.

- Improving the quality of care while maintaining costs requires a lot of detailed information. Throughout a health system, the right people need the right information at the right time, and EHR systems have the potential to provide this critical information. When implemented correctly—using a systemic approach—a well-designed EHR system can support providers, managers, policy makers, and patients by providing them with critical information and moving a country's health system toward becoming a learning health care system.

Note: all translations within this document are from the authors and professional translators and are not official ISO or country translations.

Key Definitions		
Term	**ISO Definitions**	**Spanish Translation**
Electronic Medical Record (EMR)	Electronic record of an individual in a physician's office or clinic which is typically in one setting, and is provider-centric.[a]	Registro electrónico de un individuo en el consultorio del médico o en una clínica que, generalmente, se encuentra en una sola ubicación y está centrado en el proveedor.
Electronic Health Record (EHR)	Longitudinal electronic record of an individual that contains or virtually interlines to data in multiple EMRs and Enterprise Resource Planning systems (ERPs), which is to be shared and/or interoperable across healthcare settings and is patient-centric. Patient-centric EHRs often capture data from multiple point-of-service systems and enable authorized access by the various providers of care to pertinent patient data across multiple service delivery locations or organizations in order to ensure continuity of care for the patient.[b]	Registro electrónico longitudinal de un individuo que contiene o se interrelaciona virtualmente con datos en múltiples EMR y con las sistemas de Planificación de Recursos Empresariales (ERP, por sus siglas en inglés), que debe compartirse y / o interoperarse en entornos de atención médica y que está centrado en el paciente...las EHR a menudo recopilan datos de sistemas de los puntos de atención y permiten el acceso autorizado de los proveedores de atención a datos pertinentes del paciente en múltiples ubicaciones y en las organizaciones de prestación de servicios para garantizar la continuidad de la atención al paciente.
Electronic Health Record System (EHR-S)	An EHR system will comprise one or more data repositories, directory services listing human and other resource entities, knowledge services containing terminological systems, care pathways and workflows, end user applications, reporting modules, security services, etc. The requirements for an EHR system relate closely to the functionality that end users will experience directly and will reflect the business processes to be supported at the care setting in which the system is deployed.[c]	Un sistema EHR comprenderá uno o más repositorios de datos, servicios de directorio que enumeren entidades de recursos humanos y de otro tipo, servicios de conocimiento que contengan sistemas terminológicos, vías de atención y flujos de trabajo, aplicaciones para usuarios finales, módulos de informes, servicios de seguridad, etc. Las especificaciones de un EHR-S están estrechamente relacionadas con la experiencia directa del usuario final y reflejarán los procesos de negocio del centro de atención en el que se implementa el sistema.
Electronic Health Record Architecture (EHRA)	Formal description of a system of components and services for recording, retrieving and handling information in electronic health records.[d]	Descripción formal de un sistema de componentes y servicios para registrar, recuperar y manejar información en registros electrónicos de salud.

Notes: a International Organization for Standardization. 2014. ISO/TR 14639-2: Health Informatics -- Capacity-Based eHealth Architecture Roadmap -- Part 2: Architectural Components and Maturity Model. Available at: **https://www.iso.org/standard/54903.html?browse=tc**.. **b**International Organization for Standardization. 2014. ISO/TR 14639-2: Health Informatics -- Capacity-Based eHealth Architecture Roadmap -- Part 2: Architectural Components and Maturity Model. Available at: **https://www.iso.org/standard/54903.html?browse=tc**. **c**International Organization for Standardization. 2011. ISO 18308: Health informatics — Requirements for an electronic health record architecture. Available at: **https://www.iso.org/standard/52823.html** **d**International Organization for Standardization. 2011. ISO 18308: Health informatics — Requirements for an electronic health record architecture. Available at: **https://www.iso.org/standard/52823.html**

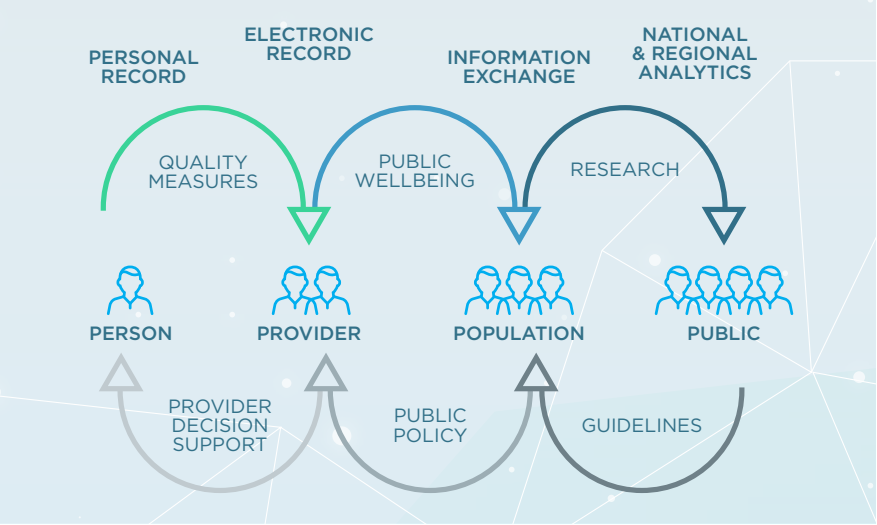
Potential and Promise of Electronic Health Record Systems for Latin America and the Caribbean

Currently, countries in Latin America and the Caribbean (LAC) are faced with the growing challenge of providing quality and efficient health care services. A 2018 publication showed that LAC's health systems are less efficient on average than those of OECD (Organization for Co-operation and Development) countries for each of the eight efficiency indicators analyzed. Among the 71 countries included in the study, 22 of 27 LAC countries were in the bottom half of the average efficiency rankings, and 12 were in the last 25 percent (Izquierdo et al., 2018). Another 2018 study of six LAC countries showed that only 40.5 percent of their patients rate the quality of their health services as "very good" or "excellent," and 87.4 percent believe that the health system needs fundamental changes (Guanais et al., 2018). Also, patients generally perceive their public-sector primary care provider as less likely to know their medical history, coordinate care, or send a reminder for their appointments than private-sector providers, but there is room for improvement system-wide. Clinical processes also pose a challenge. In the poorest communities in Central America and Mexico, less than one in every five obstetric complications and one in every ten neonatal complications are treated according to national norms (Mokdad, 2018.). In Colombia, only 15 percent of diabetic patients affiliated to contributory regime received care according to national recommended standards, including annual exams for blood sugar, cholesterol, and renal function (Pinto et al., 2018). The quality of care is also directly related to outcomes. In low- and middle-income countries, quality is a major driver of mortality. Poor-quality accounts for around 60% of deaths from conditions amenable to health care, while the remaining can be associated to utilization issues (Kruk et al., 2018). Studies in Latin America show the rate of adverse events to be around 11 percent in hospitals and 5 percent in ambulatory care (Limo et al., 2015).

Improving the quality of care while controlling costs is a challenge faced across the globe, and it is also a highly information-intensive process—the right people need the right information at the right time throughout the system to produce optimal results. EHR systems have the potential to provide critical information regarding patient care, and a well-designed EHR system can serve

as a foundation for financial systems and value-based care, support telehealth initiatives by giving various providers the necessary access to patient information and provide critical information to improve public health surveillance and research. EHR systems provide information that informs the decisions made by providers, managers, policy makers, and patients, supporting health care systems to becoming learning health care systems.[1] The learning health care system, as defined by the Institute of Medicine, is a system in which ***"science, informatics, incentives, and culture are aligned for continuous improvement and innovation, with best practices seamlessly embedded in the delivery process and new knowledge captured as an integral by-product of the delivery experience."*** (Institute of Medicine, 2013). For example, EHR systems can provide decision support tools to improve quality of care provided to an individual patient and PHR systems can support patients to take a more active role in their healthcare. At the aggregate level, information collected in those systems can inform providers about the state of public health in a geographic area. This information can feed into policy decisions and support research, which in turn, can improve clinical guidelines at the individual level.

Figure 1. Learning Health Care System Supported by ICT Tools



Source: Adapted from the Office of the National Coordinator for Health Information Technology (2014).

Despite their potential benefits in supporting improvements in efficiency and quality of care, EHR systems have been adopted at scale by only a limited number of countries in LAC. According to a recent report of the Pan-American Health Organization (PAHO), only 52.6 percent of PAHO countries have some type of national electronic health register in place, and only 26.3 percent have legislation that favors the utilization of national EHR systems (PAHO, 2016a). Currently, many LAC countries have a variety of information systems that lack information on individual patients and lack interoperable data. This means that each agency must create and maintain its own records on people so there are silos

[1] Please note that all definitions in this document appear in italics.

of duplicated information within countries and the region, and the data in the records are often of poor quality. Furthermore, the available data are often used only for reporting purposes, not for making decisions about patient care or managing processes—and international donors and organizations have not helped this issue, at times having prioritized urgent needs for data over longer-term capacity-building within a country (Abouazahr and Boerma, 2005). EHR systems represent a paradigm shift: rather than vertical silos of patient information that providers must access separately to treat their patient, EHR systems organize information around the patient to ensure that providers have the right data at the right time to provide quality care.

Some countries have undertaken this fundamental challenge of changing how data is used and organized. For example, Uruguay in 2014 created the ***Historia Clinica Electronica Nacional*** (HCEN), which adopts international standards for the exchange of clinical information. The HCEN consists of a central platform that allows for the exchange of health data and makes clinical information from various providers—both private and public—available at the point of care.[2]

Another example of health technology adoption in the region is Costa Rica's implementation of the ***Expediente Digital Único en Salud*** (EDUS) system, which began in 2012. In 2018, the implementation expanded to all levels of care provided by the Costa Rica Social Security Board (CCSS), and around 3.8 million people (77 percent of the population) had access to their unique patient record within the system nationwide.[3] Currently the CCSS is exploring how to exchange data from EDUS with other institutions.

[2] For additional information on Uruguay's Historia Clinica Electronica Nacional, please refer to https://www.agesic.gub.uy/innovaportal/v/6378/19/agesic/historia-clinica-electronica-nacional.html?padre=6377&idPadre=6377.

[3] For additional information on Costa Rica's Expediente Digital Único en Salud, please refer to https://presidencia.go.cr/comunicados/2018/09/expediente-digital-ya-esta-implementado-en-el-100-de-los-establecimientos-de-salud/.

What Is an EHR System and What Does It Do?

The terms EMR, EHR, and EHR systems—along with many others—all refer to the information in medical records that was historically kept on paper but is now frequently kept electronically. The terms can be broadly defined as patient information management systems. The terminology has evolved as electronic records have evolved, and, although official definitions to differentiate these terms exist, it should be noted that the definitions of EMR, EHR, and EHR systems—and their Spanish terms—vary significantly between countries. For the sake of simplification, this document uses the term EMR to mean an electronic record that contains medical information about a patient in a single institution over time, EHR to mean an electronic repository, not necessarily centralized, of medical information from many institutions over time, and EHR system to mean a system that combines the functions of EMRs, EHRs, and other ancillary systems while having specific functionalities that enhance what an EHR can do. It should be noted that various levels of EHRs can exist. For example, a hospital may have an EHR that stores, receives and sends data within that institution; while a state or national level EHR would store, receive and send data over a wider geographic area. How the data moves between there systems is defined at the EHR architecture (EHRA) (see Sharing EHR System Data at the National and International Level: More Than EHR Systems)

Other terms which are becoming more common include Comprehensive Health Record, Connected Health Record, and Shared Health Record. In some systems, patients control their own repository of health information, which is referred to as a personal health record (PHR)[4]. However, these terms are outside of the scope of this document.

To interpret EHR-related studies, especially while in the process of deciding which EHR system to implement, we encourage everyone to understand the various ways in which these definitions can vary and remember that a study may have relevant information about a particular functionality but refer to it with a different terminology than the one used locally.

[4] ISO defines a PHR as a "representation of information regarding or relevant to the health, including wellness, development, and welfare of a subject of care, which may be stand-alone or integrating health information from multiple sources, and for which the individual, or their authorized representative, manages and controls the PHR content and grants permissions for access by and/or sharing with other parties" (ISO, 2014). A patient poral and a PHR differ, as a patient portal provides the patient access to information controlled by a provider, while the access to PHR is controlled by the patient.

The debate about the specific definition of these systems has gone on at the global level for many years. In 2005, the International Organization for Standardization (ISO) issued guidance defining and differentiating between types of EHRs[5] (ISO, 2005). The basic-generic EHR is defined as a *"repository of information regarding the health status of a subject of care, in computer processable form."* The ISO also states that an EHR **must be able to share patient health information between authorized users of the EHR**. Lastly, the ISO norm notes that the primary role of the EHR is to support continuing, efficient, and quality integrated health care.[6] The norm does not differentiate between the functions and content required to provide quality and efficient care, as this can vary according to the context in which the technology functions (ISO, 2005).

In 2014, ISO defined EHR as the following: ***"longitudinal electronic record of an individual that contains or virtually interlines to data in multiple EMRs and ERPs, which is to be shared and/or interoperable across healthcare settings and is patient-centric".*** They also note that ***"EHRs often capture data from multiple point-of-service systems and enable authorized access by the various providers of care to pertinent patient data across multiple service delivery locations or organizations in order to ensure continuity of care for the patient."*** (ISO, 2014)

ISO defines an EHR system in the following way: ***"An EHR system will comprise one or more data repositories, directory services listing human and other resource entities, knowledge services containing terminological systems, care pathways and workflows, end user applications, reporting modules, security services, etc. The requirements for an EHR system relate closely to the functionality that end users will experience directly and will reflect the business processes to be supported at the care setting in which the system is deployed."*** (ISO, 2011)

ISO also defined an EMR as the ***"electronic record of an individual in a physician's office or clinic which is typically in one setting, and is provider-centric."*** (ISO, 2014)

What is critical to remember from these definitions is that the EHR system permits the provider to **access data from and share data with systems within and outside of their healthcare environment**, which is the key feature that differentiates an EMR from both the EHR and EHR system. Many commercial off-the-shelf products are EHR systems, not EHRs; this can be confusing because the terms EHR and EHR system are sometimes used interchangeably—especially in the US.

The literature on EHR systems often discusses the effectiveness of specific functionalities of the systems, such as the computerized decision support system (CDSS) or the computerized provider order entry (CPOE), which is important when comparing products

[5] Differentiations include the basic-generic form of the EHR, the EHR system, the Core EHR, the Extended EHR, the shared EHR, and the electronic health record for integrated care, among others

[6] This definition specifically refers to the electronic health record for integrated care as a "repository of information regarding the health status of a subject of care, in computer processable form, stored and transmitted securely and accessible by multiple authorized users, having a standardized or commonly agreed logical information model that is independent of EHR systems and whose primary purpose is the support of continuing, efficient and quality integrated health care" (ISO, 2005).

and reviewing evidence. In 2003, the Institute of Medicine defined eight core functions of an EHR system needed to improve the safety, efficiency, and quality of care. In practice, not all software systems categorized as EHR systems meet all these functions. These functions were created to provide Health Level Seven (HL7) with a set of core care delivery-related functionalities to develop an EHR Functional Model (Institute of Medicine, 2003). Although the report does not explicitly mention interoperability, it is implied in their recommendations, as they state that over time (between 2004-2010), EHR Systems should support the exchange of data across organizations, ensuring a longitudinal collection of complete health information for an individual and immediate access to patient information by all authorized users (Institute of Medicine, 2003).

Table 1. Main Functions of an EHR System According to the Institute of Medicine

Functions	Description
Storage and retrieval of health information and data	The ability to store and retrieve patients' diagnoses, allergies, lab test results, medications, etc.
Results management	The ability for all providers to assess and use new and past patients' information from different settings to improve health care processes and strategies.
Order entry/ management	The ability to enter and store orders for prescriptions, tests, and other services to enhance legibility, reduce duplication, and improve the speed with which orders are executed.
Decision support management	The ability to use reminders, prompts, alerts, and CDSS to improve compliance with best clinical practices and ensure regular screenings and other preventive practices.
Electronic communication and connectivity	The ability to ensure efficient, secure, and readily accessible communication among providers and patients.
Patient support	The ability to give patients access to their health records, thereby providing interactive patient education, and assist them in conducting home monitoring and self-testing.
Administrative processes	The ability to use automated administrative tools, such as scheduling systems.
Reporting and population health	The ability to respond more quickly to reporting requirements, including those that support patient safety and disease surveillance.

Source: Adapted from the Institute of Medicine (2003).

In 2015, the Institute of Medicine also recommended 12 social and behavioral domains be included in EHR systems to capture social determinants of health including: race or ethnic group; education; financial-resource strain; stress; depression; physical activity; tobacco use; alcohol use; social connection or isolation; intimate-partner violence; residential address; and census-tract median income (Adler and Stead, 2015).

Also in 2015, the ISO and Health Level Seven (HL7) provided a detailed reference list of functions in terms of care provision, care provision support, population health support, administration support, record infrastructure, and trust infrastructure that must be present in an EHR system to comply with the standard (ISO/HL7;2015). This level of detail is critical in settings where products are certified or national norms require that certain features be present to adhere to national/international guidelines for interoperability and real time health information exchange.

Table 2. Illustrative Examples of Select EHR Systems Functionalities

Function	Example of Functionality within Core EHR System
Health information and data	
Functions related to recording information about the patient, for example: Patient demographics, patient problem lists, medication lists, clinical notes, medical history and follow up.	Authorized provider in a public health institution enters in the information to the EHR system. Provider can view information about the patient from providers from different public and private institutions in real time. The information that the provider updates is also available to the other providers that have access to the information electronically in real time.
Order entry/management	
Functions related to the ability to enter and store orders for prescriptions, tests, and other services to enhance legibility, reduce duplication, and improve the speed with which orders are executed.	Authorized provider in the public institution enters in the information to the EHR system. Provider can view information about the past prescriptions from providers from different institutions in real time. The provider makes an order to the patient's pharmacy and in real time the pharmacy confirms that the drug is available and that the patient can pick up the prescription.
Results management	
The ability for providers to assess and use new and past patients' information from different settings to improve health care processes and strategies such as laboratory and image diagnostics.	Authorized provider in the health center orders a laboratory test and x-ray. Provider can view information about the past laboratory tests from the patients EHR and sees that a recent test was already done and therefore decides it is not necessary to repeat the test. The provider reviews them in the EHR system and refers the patient to a specialist at a different institution. The specialist can view all the past results.

Table 2. (*continuation*) Illustrative Examples of Select EHR Systems Functionalities	
Function	**Example of Functionality within Core EHR System**
Clinical decision support	
The ability to use reminders, prompts, alerts, and computerized decision support systems to improve compliance with best clinical practices and ensure regular screenings and other preventive practices. Example include warnings of drug interactions or contraindications provided; out-of-range test levels highlighted, and reminders regarding guideline-based interventions or screening in real time.	The provider enters a prescription into the EHR system. The provider receives an alert that a prescription written by another provider in a different institution counter-acts with the medication in real time from the clinical decision support tool. A different medication is prescribed to the patient.

Source: Authors elaboration, including examples and definitions of functions from Institute of Medicine (2003) and Table Structure from Des-Roches, Campbell, Rao et al. (2008),

The specific content captured by an EHR system will vary according to the services provided and the service delivery model. In general, though, the EHR system includes care provided in both inpatient and outpatient settings of primary and hospital care settings and is focused on health data. and some administrative functions. It is important to note that core requirements and functionalities will change overtime as business processes to be supported change and as the field advances.

Box 1. EHR Systems: An Analogy to Other Industries' Systems

Everyone comes across systems like the ones described in this document every day. For example, when you travel, various systems allow the airlines to manage the processes needed for air travel: bookings, verification of passenger identity, management of the flights previously booked, and reward miles tracking.

No matter which airport you visit, your airline "provider" can review all information necessary for allowing you to travel. Together, these applications are the airline's "EHR system." Each airline has their own set of applications. Some data may flow between systems, when you need to re-book a flight on a partner airline, demonstrating the interoperability of these systems.

A person's passport is their "EHR," which holds all their travel data over time, independent of which airline "provider" they use to travel. In addition, some tools help travelers manage their travel plans. For example, there are apps to check in to the flight and modify or purchase flights from a cellphone. Apps such as Apple Wallet or Samsung Pass can hold boarding passes from various airlines in the same place. You can think of these types of apps as the traveler's "personal health record."

Furthermore, there are instances when one airline needs to access information from another airline, perhaps for rebooking on another airline or sharing information such as the passenger manifest with customs and border patrol. This data can be thought of as a traveler's "patient summary" that flows between systems.

All these systems together make up the airline digital ecosystem, and the use of standards allows interoperable information to flow from system to system.

Definitions used in the Americas and Spanish Speaking Countries

Similar to the complexity found in English terms, LAC countries have no standard Spanish-language terminology and no definitions to differentiate between the various types of EHR systems or their minimum content or functionality, although this is not surprising given the complexity of the terms and systems represented. PAHO makes references to IOM, HIMSS and ISO definitions of EMRs (PAHO, 2016b) and describe EHRs as the following: ***"EHRs are patient-centered real-time files that provide immediate and secure information to authorized users. EHRs typically detail clinical histories, patient diagnoses and treatments, as well as information on drugs, allergies, vaccines, radiological imaging, and laboratory findings."*** (PAHO, 2016a). Based on their recent eHealth Survey, PAHO also notes that countries have used various terms in Spanish to describe these tools noting that, ***"Within the Region, EMRs are identified with different names according to the country. For instance, in Argentina, they are known as Electronic Health Record (Historia Clínica Electrónica) and in Colombia as Electronic Clinical Record (Registro Clínico Electrónico), while some other countries may give them the name of Digital Clinical Record (Registro Clínico Digital) or Electronic File (Ficha Electrónica)."*** (PAHO, 2016b).

Based on international standards and the experiences of five countries in LAC, the *Red Americana para la Cooperation de Salud Electronic* (Latin American Network for Electronic Health Cooperation, RACSEL) has made recommendations regarding the adoption of definitions, standards, terminology, architecture, and clinical summaries, using as a baseline the definitions or EMRs and EHRs used by HealthIT.gov in the United States (RACSEL, 2018). HealthIT.gov defined EMRs as ***"digital versions of the paper charts in clinician offices, clinics, and hospitals. EMRs contain notes and information collected by and for the clinicians used by providers for diagnosis and treatment."*** In contrast, ***"EHRs are built to go beyond standard clinical data collected in a provider's office and are inclusive of a broader view of a patient's care. EHRs contain information from all the clinicians involved in a patient's care and all authorized clinicians involved in a patient's care can access the information to provide care to that patient. EHRs also share information with other health care***

providers, such as laboratories and specialists." (HealthIT.gov, 2019). The key distinctions between these definitions are the type and scope of information included (only clinical vs. comprehensive) in the record and the availability of that information to various providers. EHRs, as opposed to EMRs, can exist within a network (all public providers within a system) and across providers (data shared between both public and private providers).

Many countries in the region have created national definitions to define these types of systems in their context. Table 3 includes terms, definitions and sources in the original language and a translation of those terms to English or Spanish. Definitions widely vary, some include key functionalities and attributes, while others are very general. Some countries have adopted international definitions and standards, while others have not. It is important to review international definitions and agree on a common term, definition and core functionalities in Spanish to create a common set of expectations about EHR system capabilities within the LAC region.

For more information, please see SPH's Digital Health Normative Map

Table 3. EHR System Definitions in the Americas and Spanish-Speaking Countries

Country	Terms and definitions in original language	Translation (abbreviations are not translated)
 Argentina	A nivel país Historia clínica Artículo 12. A los efectos de esta ley, entiéndase por historia clínica, el documento obligatorio cronológico, foliado y completo en el que conste toda actuación realizada al paciente por profesionales y auxiliares de la salud. Historia clínica informatizada Artículo 13. El contenido de la historia clínica puede confeccionarse en soporte magnético siempre que se arbitren todos los medios que aseguren la preservación de su integridad, autenticidad, inalterabilidad, perdurabilidad y recuperabilidad de los datos contenidos en la misma en tiempo y forma. A tal fin, debe adoptarse el uso de accesos restringidos con claves de identificación, medios no reescribibles de almacenamiento, control de modificación de campos o cualquier otra técnica idónea para asegurar su integridad.[a] For the city of Buenos Aires Historia clínica electrónica (HCE): Una historia clínica cuyo registro unificado, personal y multimedia se encuentra contenido en una base de datos, administrada mediante programas de computación y refrendada con firma digital del profesional tratante. Su almacenamiento, actualización y uso se efectúa en estrictas condiciones de seguridad, integridad, autenticidad, confiabilidad, exactitud, inteligibilidad, conservación, disponibilidad y acceso de conformidad con la normativa aprobada por la autoridad de aplicación de la presente ley, como órgano rector competente. El termino historia clínica electrónica (HCE) es sinónimo de historia clínica informatizada o historia clínica digital. Forman parte de la HCE los consentimientos informados, las hojas de indicaciones médicas y/o profesionales, las planillas de enfermería, los protocolos quirúrgicos, las prescripciones dietarias, los certificados de vacunación, los estudios y las prácticas realizadas, rechazadas o abandonadas. Asimismo, la HCE y el dispositivo sanitario electrónico deben contener el registro de la voluntad del paciente de donar sus órganos de acuerdo y al amparo de la Ley 3294, la Ley Nacional de Trasplante de Órganos y Tejidos n° 24.193 y su modificatoria n° 26.066 y/o la condición de donante voluntario de sangre.[b]	At the national level Health record Article 12. For the purposes of this law, health record is defined as the mandatory, chronological, numbered, and complete document in which all care provided to the patient by health care professionals and assistants is recorded. Computerized health record Article 13. A health record's contents can be in electronic format as long as all measures to preserve the integrity, authenticity, immutability, permanence, and recoverability of its data are correctly taken in a timely manner. To that end, it is necessary to implement restricted access through use of identification codes, non-rewritable storage media, field modification controls, or any other techniques designed to ensure the record's integrity. For the city of Buenos Aires Electronic health record (HCE): A centralized, personal, and multimedia medical record stored in a database, managed using computer programs, and authenticated via the digital signature of the health professional who provided the care. The record is stored, updated, and used under strict conditions of security, integrity, authenticity, reliability, accuracy, intelligibility, preservation, availability, and access in accordance with the regulations approved by the authority in charge of enforcing this law, as the agency governing this matter. The term electronic health record (HCE) is synonymous with computerized health record or digital health record. An HCE includes informed consents, indications from doctors and/or professionals, nursing forms, surgical protocols, dietary prescriptions, vaccination certificates, and the tests and analyses that were performed, rejected, or discontinued. The HCE and electronic health device should contain a record of the patient's organ donor preference, in accordance with and under Law 3294 and the National Organ and Tissue Transplant Law (No. 24.193) and its amending law (No. 26.066), and/or status as a voluntary blood donor.

Table 3. EHR System Definitions in the Americas and Spanish-Speaking Countries

Country	Terms and definitions in original language	Translation (abbreviations are not translated)
 Brazil	Artículo. 1. Definir prontuário médico como o documento único constituído de um conjunto de informações, sinais e imagens registradas, geradas a partir de fatos, acontecimentos e situações sobre a saúde do paciente e a assistência a ele prestada, de caráter legal, sigiloso e científico, que possibilita a comunicação entre membros da equipe multiprofissional e a continuidade da assistência prestada ao indivíduo.[c]	Article 1. Medical record is defined as the single document consisting of a set of information, symptoms, and images recorded, which is generated from facts, events, and situations about the patient's health and care provided, legally and confidentially, and which enables communication between members of the multidisciplinary team and continuity of care for the patient.
 Canada	Electronic health record: An electronic health record (EHR) refers to the systems that make up the secure and private lifetime record of a person's health and health care history. These systems store and share such information as lab results, medication profiles, key clinical reports (e.g., hospital discharge summaries), diagnostic images (e.g., X-rays), and immunization history. The information is available electronically to authorized health care providers.	Historia clínica electrónica: Una historia clínica electrónica (EHR) se refiere a los sistemas que conforman el registro seguro y privado del historial de salud y de la atención médica de una persona a lo largo de toda su vida. Estos sistemas almacenan y comparten información del tipo de resultados de laboratorio, perfiles de medicamentos, informes clínicos clave (por ejemplo, resúmenes de alta hospitalarias), imágenes de diagnóstico (por ejemplo, rayos X) e historial de vacunación. La información está disponible electrónicamente para proveedores autorizados de atención de la salud.
	Electronic medical record: An electronic medical record (EMR) is an office-based system that enables a health care professional, such as a family doctor, to record the information gathered during a patient's visit. This information might include a person's weight, blood pressure, and clinical information, and would previously have been handwritten and stored in a file folder in a doctor's office. Eventually, the EMR will also allow the doctor to access information about a patient's complete health record, including information from other health care providers that is stored in the EHR.	Registro médico electrónico: Un registro médico electrónico (EMR) es un sistema ubicado en el consultorio que permite a un profesional de la salud, como un médico de familia, registrar la información recopilada durante la visita de un paciente. Esta información puede incluir el peso, la presión arterial y la información clínica de una persona, y con anterioridad a la implementación del EMR habría sido escrita a mano y almacenada en una carpeta de archivos en el consultorio de un médico. Con el tiempo, la EMR también le permitirá al médico acceder a la información del registro de salud completo de un paciente, incluida la información de otros proveedores de atención médica que se almacena en el EHR.
	Personal health record: A complete or partial health record under the custodianship of a person(s) (e.g., a patient or family member) that holds all or a portion of the relevant health information about that person over their lifetime. This is also a person-centric health record, but unlike the EHR, the patient has control or "custodianship" over the record, rather than the health care provider.[d]	Registro de salud personal: Consiste en un registro de salud completo o parcial bajo la custodia de una persona (por ejemplo, un paciente o miembro de la familia), que contiene toda o parte de la información de relevante sobre la salud de esa persona durante su vida. Es también un registro de salud centrado en la persona, pero a diferencia del EHR, es el paciente y no el proveedor de la atención médica quien tiene el control o la "custodia" del registro.

Table 3. EHR System Definitions in the Americas and Spanish-Speaking Countries

Country	Terms and definitions in original language	Translation (abbreviations are not translated)
 Chile	Artículo 2. Ficha clínica es el instrumento obligatorio donde se registra el conjunto de antecedentes relativos a las diferentes áreas relacionadas con la salud de una persona, que cumple la finalidad de mantener integrada la información necesaria para el otorgamiento de atenciones de salud al paciente. Las fichas clínicas podrán llevarse en soporte de papel, electrónico, o de otro tipo, y su contenido se registrará por el profesional que efectúa la prestación de salud, en el acto de otorgarla o inmediatamente después de ello. La información contenida en las fichas clínicas será considerada datos sensibles, de conformidad con lo establecido en el artículo 2º, letra g) de la ley nº 19.628.[e]	Article 2. A medical file is a compulsory method of recording the complete history of the different aspects of a person's health. Its purpose is to gather and store the information needed to provide health care to a patient. Medical files can be kept on paper, electronically, or by other means. Their content is to be recorded by the professional who provides the health care service, either upon providing it or immediately afterward. The information in medical files is classified as sensitive, as established in Article 2(g) of Law No. 19.628.
 Colombia	Historia clínica electrónica: Es el registro integral y cronológico de las condiciones de salud del paciente, que se encuentra contenido en sistemas de información y aplicaciones de *software* con capacidad de comunicarse, intercambiar datos y brindar herramientas para la utilización de la información refrendada con firma digital del profesional tratante. Su almacenamiento, actualización y uso se efectúan en estrictas condiciones de seguridad, integridad, autenticidad, confiabilidad, exactitud, inteligibilidad, conservación, disponibilidad y acceso, de conformidad con la normatividad vigente.[f]	Electronic health record: The integrated and chronological record of a patient's health conditions, which is contained in information systems and health applications with the ability to communicate, exchange data, and provide tools for the use of the information endorsed with digital signature of the health professional treating the patient. Its storage, updating, and use is carried out under strict conditions of security, authenticity, reliability, accuracy, intelligibility, conservation, availability, and access, in accordance with current regulations.
 Costa Rica	Expediente digital único de salud: Cada persona debe tener un expediente electrónico con la información de toda la historia de atención médica, con las características de disponibilidad, integridad y confidencialidad.[g] Se busca promover la interoperabilidad de la información, el procesamiento, la confidencialidad, la seguridad y el uso de estándares y protocolos entre las distintas entidades del sector salud, de forma tal que se tenga acceso seguro y oportuno a la información de las personas que requieren atención, conforme a los principios del consentimiento informado y la autodeterminación informativa.[h]	Unified digital health record: An easily available, accurate, and confidential electronic file for each person, with information on his or her entire medical history. Promote the interoperability of information, processing, confidentiality, security, and the use of standards and protocols between the different entities of the health sector to provide safe and timely access to the information on people in need of care, in accordance with the principles of informed consent and informational self-determination.

Table 3. EHR System Definitions in the Americas and Spanish-Speaking Countries

Country	Terms and definitions in original language	Translation (abbreviations are not translated)
 Ecuador	La historia clínica electrónica (HCE) es un registro electrónico personal, resultado de una atención de salud, que se encuentra contenido en una base de datos, generada mediante programas informáticos, y certificada con la firma electrónica del profesional de la salud. Sin perjuicio de que los establecimientos prestadores de servicios de salud sean custodios de la HCE, los pacientes son los titulares de los datos que respecto de ellos se almacene en la HCE. Se considera HCE activa a aquella que tiene un periodo de vigencia de hasta cinco años desde la última atención registrada; e, HCE inactiva es, en cambio aquella que no tiene ningún registro de atención por más de cinco años y que por tanto debe ser trasladada al archivo pasivo.[i]	An electronic health record (HCE) is a personal, digital record resulting from a health care action, and which is stored in a database. It is generated using computer programs and certified with the electronic signature of the health professional. Though health care establishments may be the custodians of the HCEs, patients own any data pertaining to them that is stored in that record. Active HCEs are those in which a health care action has been logged within the last five years. Inactive HCEs are those with no health care action recorded for more than five years; these should be moved to passive storage.
 Mexico	Expediente clínico electrónico, sistema ECE: Es el medio electrónico en el cual el personal de salud deberá registrar, anotar y certificar su intervención, relacionada con el paciente con arreglo a las disposiciones sanitarias. Permite la gestión de un único registro de salud longitudinal de cada paciente en un formato digital.[j] Los expedientes clínicos electrónicos que estarán sujetos a la presente norma serán aquellos destinados a los siguientes usos en el ámbito de la provisión de servicios de salud: consulta externa; hospitalización; urgencias; farmacia; laboratorio; imagenología; y quirófano.[k]	Electronic medical file, ECE system: This is the digital medium health care professionals should use to record, log, and certify their actions in relation to patients and in accordance with health regulations. It allows for the digital management of a single, comprehensive health record for each patient. The electronic medical files subject to this regulation are those intended for the following uses within the sphere of health care: outpatient care, hospitalization, emergencies, pharmacy, laboratory, medical imaging, and surgery.
 Panama	El registro médico electrónico (o historia clínica electrónica): es el registro en formato electrónico de información sobre la salud de cada paciente que puede ayudar a los profesionales de salud en la toma de decisiones y en el tratamiento.[l]	Electronic medical record (or electronic health record): The digital record of information on each patient's health that can help health care professionals make decisions and provide treatment.

Table 3. EHR System Definitions in the Americas and Spanish-Speaking Countries

Country	Terms and definitions in original language	Translation (abbreviations are not translated)
 Peru	Historia clínica electrónica: Historia clínica cuyo registro unificado y personal, y multimedial, se encuentra contenido en una base de datos electrónica, registrada mediante programas de computación y refrendada con firma digital del profesional tratante. Su almacenamiento actualización y uso se efectúan en estrictas condiciones de seguridad, integralidad, autenticidad, confidencialidad, exactitud, inteligibilidad, conservación, disponibilidad y acceso, de conformidad con la normativa aprobada por el Ministerio de Salud, como órgano rector competente.[m]	Electronic health record: A centralized, personal, and multimedia medical record stored in an electronic database, recorded using computer programs, and authenticated with the digital signature of the professional who provided the care. The record is stored, updated, and used under strict conditions of security, comprehensiveness, authenticity, confidentiality, accuracy, intelligibility, preservation, availability, and access, in accordance with the regulations approved by the Ministry of Health, as the agency governing this matter.
 Spain	La historia clínica comprende el conjunto de los documentos relativos a los procesos asistenciales de cada paciente, con la identificación de los médicos y de los demás profesionales que han intervenido en ellos, con objeto de obtener la máxima integración posible de la documentación clínica de cada paciente, al menos, en el ámbito de cada centro.[n] La historia clínica digital del Sistema Nacional de Salud tiene como finalidad garantizar a ciudadanos y profesionales sanitarios el acceso a la documentación clínica más relevante para la atención sanitaria de cada paciente. Se incluye documentación que se encuentre disponible en soporte electrónico en cualquier lugar del SNS, asegurando a los ciudadanos que la consulta de sus datos queda restringida a quien esté autorizado para ello.[o] Región de Catalonia La historia clínica compartida en Cataluña (HC3) es la historia electrónica que agrupa el conjunto de documentos que contienen datos e información relevante sobre la situación y la evolución de un paciente a lo largo de su proceso asistencial. La HC3 permite el acceso de manera organizada, y siempre bajo los parámetros idóneos de seguridad y confidencialidad, a la información relevante de las historias clínicas de los diferentes centros sanitarios de la red pública asistencial. La HC3 consigue también, mediante mecanismos de interoperabilidad y el uso de estándares entre sistemas de información, que las diferentes historias clínicas de los centros sanitarios de la red pública asistencial sean compatibles para poder acceder a toda la información sanitaria y de salud de un paciente con independencia del lugar y el momento en que se necesitan.[p]	A health record is the set of documents on each patient's health care processes, identifying the physicians and other professionals who participated in those processes. Its purpose is to integrate each patient's medical documentation to the greatest extent possible, at least at the level of each health center. The purpose of the digital health record of the National Health System is to ensure that citizens and health care professionals have access to the most relevant medical documents for each patient's health care. It includes documents available in digital format anywhere within the National Health System and provides a guarantee to citizens that their information can only be consulted by persons authorized to do so. Catalonia region The shared health record in Catalonia (HC3) is the electronic health record containing the set of documents with relevant data and information about a patient's status and condition throughout their health care path. The HC3 provides organized access, which is always adherence with proper security and confidentiality protocols, to the relevant information in the medical records of the different health centers in the health care network. Through interoperability mechanisms and the use of standards between information systems, the HC3 also makes the different medical records of the health centers in the public health system compatible so that all medical and health care information on a patient can be accessed anywhere and anytime.

Table 3. EHR System Definitions in the Americas and Spanish-Speaking Countries

Country	Terms and definitions in original language	Translation (abbreviations are not translated)
 United States	An electronic health record (EHR) is a digital version of a patient's chart. EHRs are real-time, patient-centered records that make information available instantly and securely to authorized users. EHRs are a vital part of health IT and can: contain a patient's medical history, diagnoses, medications, treatment plans, immunization dates, allergies, radiology images, and laboratory and test results; allow access to evidence-based tools that providers can use to make decisions about a patient's care; and automate and streamline provider workflow. One of the key features of an EHR is that health information can be created and managed by authorized providers in a digital format capable of being shared with other providers across more than one health care organization.[q]	Una historia clínica electrónica (EHR) es una versión digital de la historia clínica de un paciente. Las EHR son registros centrados en el paciente en tiempo real que hacen que la información esté disponible de forma instantánea y segura para los usuarios autorizados. Las EHR son una parte fundamental de la TI sanitaria y pueden contener el historial médico del paciente, diagnósticos, medicamentos, planes de tratamiento, fechas de vacunación, alergias, imágenes de radiología y resultados de laboratorio y pruebas; pueden permitir el acceso a herramientas basadas en evidencia que los proveedores pueden usar para tomar decisiones sobre la atención de un paciente, y pueden automatizar y optimizar el flujo de trabajo del proveedor. Una de las características clave de una EHR es que la información de salud puede ser creada y administrada por proveedores autorizados en un formato digital que permite ser compartido con otros proveedores en más de una organización de salud.
	Electronic Medical Records (EMRs) are a digital version of the paper charts in a clinician's office. An EMR contains the medical and treatment history of the patients in one practice. EMRs allow clinicians to track data over time, easily identify which patients are due for preventive screenings or checkups, check how their patients are doing on certain parameters, and monitor and improve quality of care within the practice. But the information in EMRs doesn't travel easily out of the practice.[r]	Los registros médicos electrónicos (EMR) son una versión digital de los expedientes en papel en el consultorio del médico. Un EMR contiene el historial médico y de tratamiento de los pacientes en una práctica. Los EMR permiten a los médicos rastrear datos en el tiempo, identificar fácilmente a qué pacientes se les debe realizar exámenes preventivos o chequeos, verificar cómo les va a sus pacientes en ciertos parámetros, y supervisar y mejorar la calidad de la atención en la consulta. La información contenida en los EMR no sale fácilmente de la consulta.
	Electronic health information exchange (HIE) allows doctors, nurses, pharmacists, other health care providers and patients to appropriately access and securely share a patient's vital medical information electronically—improving the speed, quality, safety and cost of patient care.[s]	El intercambio electrónico de información de salud (HIE) permite a los médicos, enfermeras, farmacéuticos, otros proveedores de atención de la salud y pacientes acceder y compartir de manera segura la información médica vital de un paciente electrónicamente, mejorando la velocidad, la calidad, la seguridad y el costo de la atención al paciente.
	A personal health record, or PHR, is an electronic application through which patients can maintain and manage their health information (and that of others for whom they are authorized to do so) in a private, secure, and confidential environment.[t]	Un registro de salud personal, o PHR, es una aplicación electrónica a través de la cual los pacientes pueden mantener y administrar su información de salud (y la de otros para quienes están autorizados) en un entorno privado, seguro y confidencial.

Table 3. EHR System Definitions in the Americas and Spanish-Speaking Countries

Country	Terms and definitions in original language	Translation (abbreviations are not translated)
 Uruguay	Artículo 2(A). Una historia clínica electrónica es el conjunto integral de datos clínicos, sociales y económicos, referidos a la salud de una persona, desde su nacimiento hasta su muerte, procesados a través de medios electrónicos, siendo el equivalente funcional de la historia clínica en papel.[u]	Article 2(A). An electronic health record is a comprehensive set of electronically processed medical, social, and economic data on a person's health from their birth until their death. It is the functional equivalent of a paper health record.
	Artículo 2(C). Plataforma de Historia Clínica Electrónica Nacional: es la infraestructura tecnológica y de servicios que permite la conectividad de los diferentes sistemas de información del conjunto de Instituciones con competencias legales en materia de salud, públicas y privadas, con el objetivo de intercambiar información clínica[v]	Article 2(C). The National Electronic Health Record Platform is the infrastructure of technologies and services that facilitates the interconnection among the information systems of all the public and private institutions with legal powers or duties related to health care for the purpose of exchanging medical information.
	Artículo 14. Se entiende por Sistema de Historia Clínica Electrónica Nacional el conjunto de personas e instituciones, procedimientos y tecnologías, que interactúan para viabilizar el intercambio de información clínica y contribuir a la continuidad asistencial de los usuarios y pacientes.[w]	Article 14. The National Electronic Health Record System is the set of people and institutions, procedures, and technologies that interact to make it possible to exchange medical information and achieve continuity of care for users and patients.
	Historia Clínica Electrónica Nacional (HCEN): El principal cometido de la HCEN es promover y mejorar la continuidad del proceso asistencial de los usuarios del sistema de salud uruguayo, mediante un mecanismo que permite unificar y hacer disponible toda la información clínica del usuario de Salud ante un evento asistencial. A través de la HCEN, la información clínica del ciudadano estará disponible y accesible para el equipo de la Salud de forma oportuna, segura y en línea, independientemente del lugar geográfico y del prestador de Salud donde se presente el usuario.[x]	National electronic health record (HCEN): The purpose of an HCEN is to promote and enhance continuity of care for users of the Uruguayan health system by using a mechanism that standardizes and provides access to complete information on health care users when they need care. The HCEN gives health care teams quick, secure, and online access to citizens' medical information, regardless of the user's geographic location and health care provider.

Note: The original texts have been lightly edited and formatted to increase readability and comprehension within this table.
aLey 26.529, Derechos del Paciente, Historia Clínica y Consentimiento Informado, Art. 12–13. *Boletín Oficial*. Published November 20, 2009. (October 21, 2009.) Ministry of Justice and Human Rights, Argentina, SAIJ: LNS0005549. http://www.saij.gob.ar/26529-nacional-derechos-paciente-historia-clinica-consentimiento-informado-lns0005549-2009-10-21/123456789-0abc-defg-g94-55000scanyel?q=%28numero-norma%3A26529%20%29&o=0&f=Total%7CTipo%20de%20Documento/Legislaci%F3n/Ley%7CFecha%7COr. **b**Ley 5.669, Ley de Historia Clínica Electrónica, Art. 14. Published December 2, 2016. (November 22, 2016). Centro de Documentación Municipal, *BOCBA* No. 5019. http://www2.cedom.gob.ar/es/legislacion/normas/leyes/ley5669.html. **c**Federal Council of Medicine, Brazil (2002). **d**Canada Health Infoway (n.d.). **e**Ministry of Health, Chile (2012). **f**Ley No. 2015, Por Medio del Cual Se Crea la Historia Clínica Electrónica Interoperable y Se Dictan Otras Disposiciones, Art. 2. Published January 31, 2020. https://dapre.presidencia.gov.co/normativa/normativa/LEY%202015%20DEL%2031%20DE%20ENERO%20DE%202020.pdf **g**Norma 9162, Expediente Digital Único de Salud, Art. 3(c). (August 26, 2013.) Procuraduría General de la República, Sistema Costarricense de Información Jurídica. http://www.pgrweb.go.cr/scij/Busqueda/Normativa/Normas/nrm_texto_completo.aspx?param1=NRTC&nValor1=1&nValor2=75700&nValor3=93998&strTipM=TC. **h**Norma 9162, Expediente Digital Único de Salud, Art. 3(e). (August 26, 2013.) Procuraduría General de la República, Sistema Costarricense de Información Jurídica. http://www.pgrweb.go.cr/scij/Busqueda/Normativa/Normas/nrm_texto_completo.aspx?param1=NRTC&nValor1=1&nValor2=75700&nValor3=93998&strTipM=TC. **i**Acuerdos 0009-2017, Expídese el Reglamento para el Manejo de la Historia Clínica Electrónica. Published March 22, 2017. https://2019.vlex.com/#vid/671988073. **j**Norma Oficial Mexicana NOM-024-SSA3-2010, Sec. 3.40. *Diario Oficial de la Federación*. Published August 17, 2010. Secretaría de Salud. http://www.dof.gob.mx/normasOficiales/4151/salud/salud.htm. **k**Norma Oficial Mexicana NOM-024-SSA3-2010, Sec. 5.4–5.4.7. *Diario Oficial de la Federación*. Published August 17, 2010. Secretaría de Salud. http://www.dof.gob.mx/normasOficiales/4151/salud/salud.htm. **l**Ministry of Health, Panama (2016). **m**Ley 30024, Ley que crea el registro nacional de historias clínicas electronicas. *El Peruano*. Published May 22, 2013. https://cdn.www.gob.pe/uploads/document/file/269432/240527_Ley30024.pdf20190110-18386-1pq5p0z.pdf. **n**Ley 41/2002, Básica Reguladora de la Autonomía del Paciente y de Derechos y Obligaciones en Materia de Información y Documentación Clínica. *Boletín Oficial del Estado*. Published November 15, 2002. Modified December 6, 2018. BOE-A-2002-22188. https://www.boe.es/buscar/pdf/2002/BOE-A-2002-22188-consolidado.pdf. **o**Ministry of Public Health, Consumer Affairs and Social Welfare, Spain (n.d.). **p**Department of Health, Spain (2018). **q**Office of the National Coordinator for Health Information Technology, United States (n.d.a). **r**Garrett, P., and J. Seidman (2011). **s**Office of the National Coordinator for Health Information Technology, United States (n.d.b). **t**Office of the National Coordinator for Health Information Technology, United States (n.d.c). **u**Decreto No 242/017, Art. 2(A). IMPO, Centro de informacion oficial. Published September 7, 2017. (Enacted August 31, 2017.) https://www.impo.com.uy/bases/decretos/242-2017. **v**Decreto No 242/017, Art. 2(C). IMPO, Centro de informacion oficial. Published September 7, 2017. (Enacted August 31, 2017.) https://www.impo.com.uy/bases/decretos/242-2017. **w**Decreto No 242/017, Art. 14. IMPO, Centro de informacion oficial. Published September 7, 2017. (Enacted August 31, 2017.) https://www.impo.com.uy/bases/decretos/242-2017. **x**Agency for Development of Government Electronic Management and Information Society and Knowledge, Uruguay (2019).

Sharing EHR System Data at the National and International Level: More Than EHR Systems

For information to be interoperable—or shared and understood by various providers within a network—it is necessary to agree on the subset of data to be shared with and made available to all providers treating the patient.[7] For example, in the United States, this data is referred to as the U.S. Core Data for Interoperability,[8]and in Uruguay, it is defined as the minimum dataset to be shared in the national electronic health record.[9] In its document describing international recommendations for interoperability, RACSEL also proposed a patient summary for EHR interoperability at the regional level in LAC (RACSEL, 2018).

A critical element to facilitate information exchange at the national level is the EHR system architecture (EHRA). ISO defined EHRA as a *"formal description of a system of components and services for recording, retrieving and handling information in electronic health records"* (ISO, 2011). Depending on the country, the national EHRA may include multiple EHR systems used by various providers and organizations, and additional systems and repositories that permit the exchange of information among these systems, such as a Health Information Exchange (HIE). HIMSS defines a HIE as platforms which *"provide the capability to electronically move clinical information among disparate healthcare information systems and maintain the meaning of the information being exchanged"* (HIMSS, 2019).

[7] For more information on interoperability, please refer to Interoperability for Beginners: The Basis of Digital Health.
[8] For more information, please refer to https://www.healthit.gov/isa/us-core-data-interoperability-uscdi.
[9] See Article 8, Annex 1 of Decreto N° 122/019.

Box 2: Examples of types of information exchange

There are various ways to exchange health data.
As an example, HealthIT.gov defines three key types of exchange:

- **Directed Exchange** – ability to send and receive secure information electronically between care providers to support coordinated care
- **Query-based Exchange** – ability for providers to find and/or request information on a patient from other providers, often used for unplanned care
- **Consumer Mediated Exchange** – ability for patients to aggregate and control the use of their health information among providers (HealthIT.gov, 2019)

There are many ways and architectures which can permit the exchange of information at the national or subnational level. It is critical for the national government to define their digital health architecture to allow for data exchange across the digital ecosystem.

It is important to remember that EHR systems capture mainly clinical processes and need to be complemented by systems related to administrative processes, such as costs, billing, logistics, and human resource management. Such administrative systems are referred to as enterprise resource planning solutions and are not discussed in this document, but it is important to note their importance in building a health system that effectively functions as more than a patient information management system. To understand the critical inputs for systems and enabling factors that are needed for a health information ecosystem, publications such as the ISO's capacity-based eHealth architecture roadmap (ISO, 2014) and PAHO's Information Systems for Health (IS4H) Toolkit (PAHO, 2019) offer useful guidance.

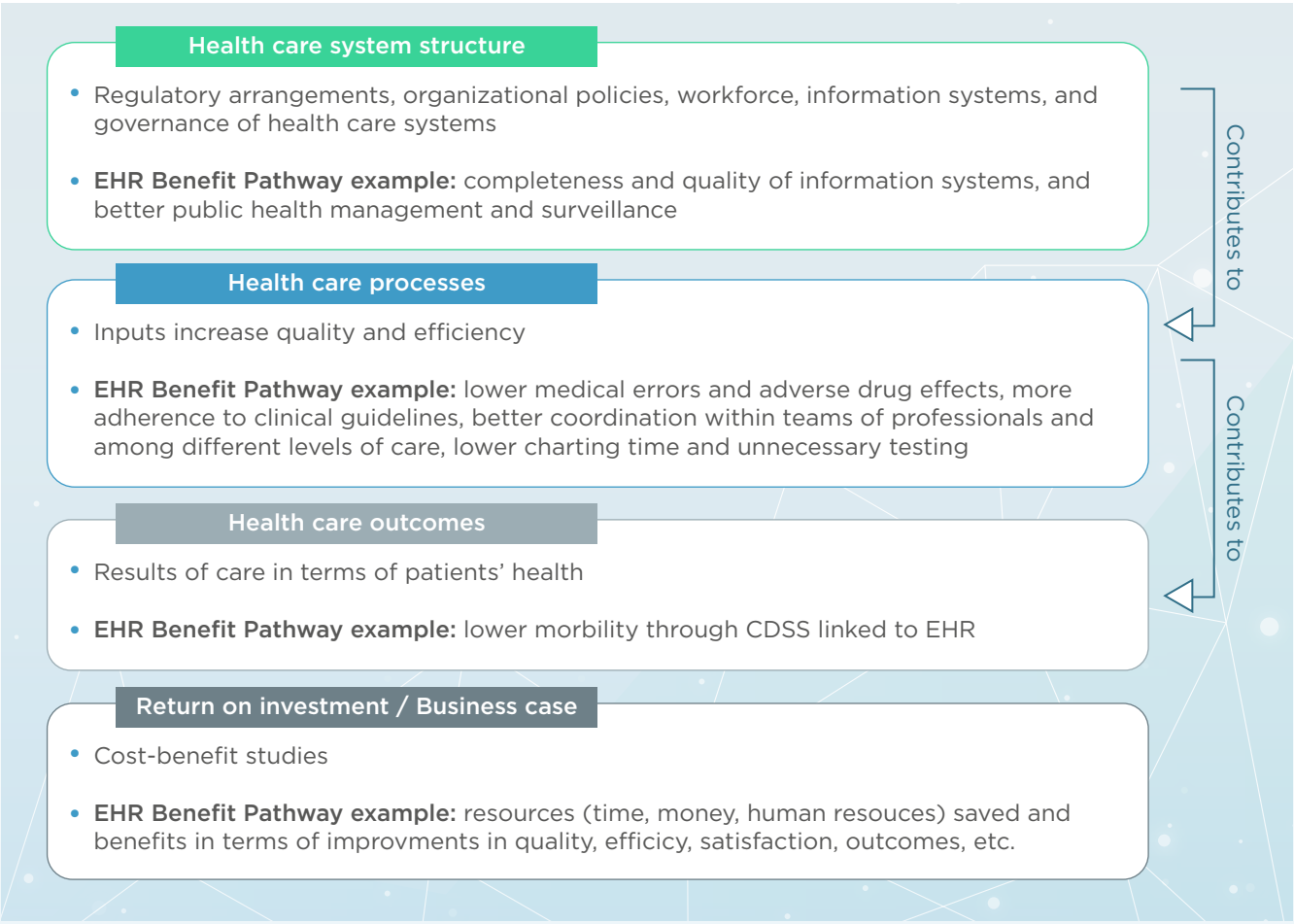
Do EHR Systems Actually Work?

To determine whether EHR systems work, we carried out an assessment of studies from peer-reviewed journals, although we acknowledge that there are also many articles in the media. Given the high risk of context-based bias when assessing the impact of an EHR system, we privilege evidence from systematic literature reviews published over the last 10 years.[10] Note that this document does not present a comprehensive review on all possible benefits related to the implementation of EHR systems, but rather a selection of available evidence for explanatory purposes.

We find four main effects of EHR systems in the literature and build upon the logic framework of Hyppönen et al. (2014) as a basis for organizing the four areas, which are health care system structures, health care processes, health care outcomes, and return on investment. Health care system structures refer to the health system inputs used to improve the health and well-being of people. These inputs include regulatory arrangements, organizational policies, workforce, information systems, and governance of health care systems. Health care processes refer to how these inputs are used to improve the health and well-being of people and mainly refer to the quality and efficiency of care. Next, health care outcomes refer to the results of care in terms of patients' health. Finally, return on investment is an important finding about cost-benefit studies for EHR systems.

[10] Note that limited evidence is available from low- and middle-income countries, such as most LAC countries, so the majority of the evidence presented here is from developed countries.

Figure 3. Logic Framework for EHR System Benefits



Source: Authors' elaboration based on the logic framework of Hyppönen et al. (2014).

>> Health Care System Structure

In terms of health care system structure, the main benefit of EHR systems concerns the completeness and quality of information systems. A literature review on benefits and drawbacks associated with the EHR system implementations reported that EHR systems commonly contribute to higher information availability and accuracy as well as timely access to up-to-date information (Nguyen, Belluci and Nguyen, 2014). An Austrian study on diabetes mellitus care showed that a comprehensive nationwide EHR system would multiply the patient health information available for a typical hospital visit, as the median ratio of external to local medical documents available was up to 39:1 (Rinner et al., 2016). Note that the ratio of external to local documents is a metric of the volume of information available. This metric is related to the implementation of the EHR system, as the EHR system favors access to external medical documents. Additionally, EHR systems favor better public health management and surveillance, as they can provide alerts to better predict outbreaks. Recent studies on this effect have shown that prediction models based on EHRs forecasted influenza outbreaks better and faster than traditional surveillance systems (Michiels et al., 2017; Yang et al., 2017). For example, a prediction model based on EHRs and internet search activities reduced the prediction errors (i.e., the root mean squared errors) of real-time and three-week-ahead forecasts by 33 percent and 21 percent, respectively (Yang et al., 2017). EHR-related information improvements can also have positive externalities in terms of research, as EHR-based studies often rely on large sample sizes, and EHR data is more economical and faster to collect (Menachemi and Collum, 2011; Casey et al., 2016).

>> Health Care Processes

In terms of health care processes, the evidence suggests that correctly implemented EHR systems improve the quality and efficiency of care. A systematic review of 47 studies concluded that EHR systems enhance quality of care, as they are associated with lower medical errors (risk ratio [RR] = 0.46, confidence interval [CI] = 0.38–0.55) and adverse drug effects (RR = 0.66, CI = 0.44–0.99) as well as with higher adherence to clinical guidelines (RR = 1.33, CI = 1.01–1.76) (Campanella et al., 2015). For example, a US study found that compliance with quality diabetes care standards was higher in EHR-based practices than in paper-based practices: measurement of glycated hemoglobin was 7.2 percentage points (pp) higher in EHR-based practices compared to paper-based practices, and eye examination was 25.0 pp higher (Cebul et al., 2011).[11] As for medical errors, a 2019 study on clinical mistakes among people living with HIV on antiretroviral therapy showed that an EHR system providing administration instructions and dosing defaults in order entry screens contributed to reducing the medication error rate from 50.2 to 28.2 percent (Pettin et al., 2019). Other possible quality improvements include better

[11] All of these figures refer to the adjusted differences between EHR-based practices and paper-based practices.

follow-up of test results and better coordination within teams of professionals and among different levels of care (Nguyen et al., 2014). The utilization of an integrated inpatient-outpatient EHR system was shown to be associated with higher subjective measures of agreement among professionals on roles and responsibilities as well as better agreement on patients' treatment goals across different delivery sites (Graetz et al., 2014).

In terms of health care efficiency, the evidence highlights the potential of EHR systems to promote efficiency gains in health care delivery. A review of 18 studies from Australia, Belgium, Canada, Germany, Israel, Italy, Netherlands, Finland, and the United States concluded that patient data management systems decrease charting time and increase time spent on patient care (Cheung et al., 2015). For example, EHR-related tools have been shown to reduce by 50 percent the time spent on hand-copying basic data from patients (Li et al., 2012; Van Eaton et al., 2005). Another literature review on the benefits and drawbacks of EHR systems reported that EHR systems reduce the cost of redundant diagnostics (Menachemi and Collum, 2011). Unnecessary tests are common in the absence of an EHR system, as providers do not have access to patients' clinical information stored by other providers. Nonetheless, the literature review of Nguyen, Belluci, and Nguyen (2014) on the impact of EHR implementation highlighted mixed results on efficiency. The main efficiency drawbacks were related to disruptive changes in workflows and workloads that affect productivity and can lead to physician burnout as well as increased time spent on computers (i.e., desktop-medicine) (Nguyen et al., 2014; Menachemi and Collum, 2011; Downing, Bates and Longhurst, 2018). US physicians in the primary care setting have been shown to spend around 6 hours per day interacting with the EHR system (Arndt et al., 2017). Even if EHR interactions include logging for patient care and non-face-to-face activities, two third of the logged time was dedicated to inbox and clerical activities. These work efficiency issues can be avoided by implementing change management and training strategies. For example, a recent US study found that an EHR system training that includes coaching, facilitation, and demonstrations contributed to improvements in work efficiency and quality of care. In particular, it resulted in time savings on EHR documentation of 40 to 60 minutes per day for 78 percent of physicians as well improvements in the physicians' use of order sets for health issues such as stroke, sepsis, and chest pain (Robinson and Kersey, 2018).

>> Health Care Outcomes

Evidence on the impact of EHR systems is less strong when it comes to health care outcomes. The systematic review with meta-analyses by Thompson et al. (2015) assessed the impact of EHR systems on mortality in hospitals and intensive care units and did not find substantial effects of EHR systems on mortality. A qualitative assessment of the 45 studies included in the review showed

great heterogeneity in the results, suggesting that the impact on mortality largely depends on the context and disease characteristics. However, evidence on the impact of EHR-related tools on morbidity is more convincing. For example, Moja el al. (2014) conducted a literature review on the impact of CDSSs[12] linked to EHR systems in terms of both mortality and morbidity. The review confirmed no substantial benefit in terms of mortality but presented a reduction in the summary relative risk of morbidity in the order of 10 to 18 percent.

>> Return on Investment / Business Case

In addition to reviewing EHR-system inputs, processes, and outcomes, it is important to review the available evidence on the cost and cost-benefits of EHR systems. Similar to the evidence on health care outcomes, evidence on the cost and cost-benefit of EHR systems is highly context specific and largely depends on how EHR systems are implemented. It is still unclear whether EHR system implementation increases or decreases the costs for health care organizations (Thompson et al. 2015) and if the benefits associated with EHR implementation outweigh the costs (Reis et al., 2017). However, evidence from countries with advanced EHR implementation experiences suggests that EHR systems have a positive return on investment if correctly implemented. For example, in the United States, the Department of Veterans Affairs has benefits equal to three times the annual costs of implementing its digital systems (Byrne et al., 2010). Positive return on investment related to EHR implementation has also been found in the primary health care setting. A Canadian study including 17 primary care clinics found an average break-even point, or time necessary to complete cost recovery after the initial investment, of 10 months (Jang, Lortie and Sanche, 2014). The return on investment is mostly driven by the ability of physicians to see more patients in the same time and increased efficiency of administrative personnel.

To summarize, although some mixed results were reported in each category, overall evidence supports implementing EHR systems. Strong evidence exists for health care system structures and processes (i.e., quality and efficiency of care), whereas evidence is less strong for health care outcomes. It is also important to note that since the main objective of an EHR system is to support continuing, efficient, and quality integrated health care, it is to be expected that the main effects are concentrated on health care processes. A less clear effect on outcomes was also expected because the health of patients is influenced by a variety of economic, epidemiologic, and demographic factors as well as health system characteristics. Therefore, EHR systems should not be considered as a silver bullet that can single-handedly improve health outcomes, especially if the systems are not an integral component of a wider health care strategy.

[12] Computerized Decision Support Systems are rule based or machine learning based tools to help healthcare providers with diagnostics or prescriptions.

Table 4. Summary of Main Effects of EHR Systems

Structures	Processes	Outcomes	Return on investment / Business Case
• Completeness and quality of information systems • More accurate information that is updated frequently and accessed quickly • Improvements in research quality and timely access to higher-quality information • Better public health surveillance and management	• Quality of patient care is enhanced—EHR systems are positively associated with adherence to clinical guidelines, lower medical errors, and lower adverse drug effects • Better follow-up on test results and coordination among different levels of care and within teams of health care professionals • Cost of redundant diagnostics is reduced • Time spent copying data from patients is reduced • Disruptive changes in workflows increase • Physician burnout increases	• No substantial effects on mortality or length of stay in hospital settings • CDSSs linked to EHRs show reduced relative risk of morbidity in the order of 10 percent–18 percent	• Mixed results depending on context, but examples of positive rates of return and short recovery times in advanced implementations

Source: Adapted from Nelson et al. (2019).

Common Barriers to Adopting EHR Systems

Knowing the main barriers health systems will encounter is fundamental for successful planning and implementation of EHR systems. In this section, we provide an overview of the main barriers to implementing EHR systems found in the literature.

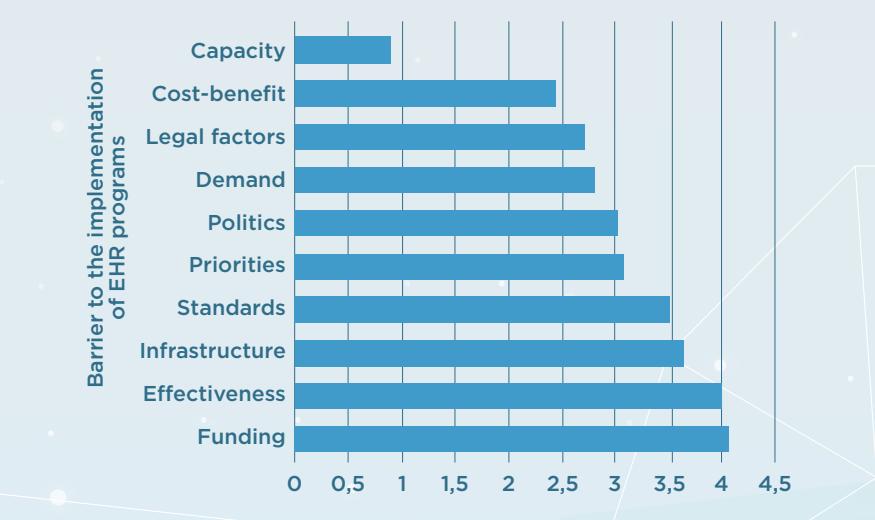
A good taxonomy of barriers is provided by Boonstra and Broekhuis (2010). They identified a comprehensive list of barriers to physicians adopting EHR systems and grouped them into eight categories: financial, technical (e.g. connectivity, computers, skilled human resources), time, psychological, social, legal, organizational, and change process. The financial, technical, and time barriers are considered to be the primary barriers, as they are more often identified as potential threats to EHR systems' adoption. However, overcoming the primary barriers is not enough to ensure the realization of EHR-related benefits (Boonstra and Broekhuis, 2010). For example, change management barriers (e.g., lack of incentives, participation, leadership) can hamper a successful implementation of an EHR system even when financial and technical resources are available.

In line with these results, a PAHO study showed that the primary barriers to EHR implementation are financial and technical (i.e., lack of infrastructure, such as equipment and connectivity, and lack of standards for interoperability)[13] (Figure 4). The results of this study are based on the World Health Organization's Third Global Survey on eHealth, which was administered in 2015 to key stakeholders identified by health ministries and secretariats in PAHO Member States. Respondents were asked to assess 10 barriers to EHR implementation on a five-point Likert scale ranging from "it is not a barrier" to "it is an extremely important barrier." While a survey to identify barriers is not the best tool since results may reflect biases and incomplete information on the part of those who answer it, lack of funding was reported as a "very important" or "extremely important" barrier to EHR implementation by 73.7 percent of respondents, whereas lack of infrastructure and lack of interoperability standards were considered as a "very important" or "extremely important" barrier by 68.4 percent and 57.9 percent of respondents, respectively. It is worth noting that human-related barriers, such as lack of importance, lack of

[13] Note that, as shown in Figure 4, the lack of definitive evidence on the effectiveness of EHR systems was also reported as an important barrier (second in order of importance). This barrier can be related to the barrier "lack of funding." Particularly, the difficulties in obtaining funding for EHR projects might be explained by a lack of definitive evidence documenting the effectiveness of EHR systems.

political will, lack of demand, and lack of digital skills were also considered challenges to implementing EHR systems.

Figure 4. Barriers to Establishing EHR Systems



Source: PAHO (2016b, 45).
Note: Scores are averages on a five-point Likert scale, with 1 corresponding to "it is not a barrier" and 5 corresponding to "it is an extremely important barrier."

A common mistake among implementers of EHR systems is underestimating human-related barriers. Overall, one of the key points emerging from the literature on challenges is that a successful EHR implementation does not depend only on financial and technical barriers—it also depends on people. Overcoming financial and technical barrier is a necessary condition for an effective implementation of EHR systems, but it is not sufficient. The critical importance of human-related barriers is confirmed by the results of a recent study that compared the implementation of nationwide EHR systems in 13 countries, based on a survey for experts that had key roles during the EHR implementation process (Fragidis and Chatzoglou, 2018). The study concluded that the most critical barrier to effectively implementing an EHR system is actually the lack of support and negative reactions from stakeholders, such as health care professionals and managers (Fragidis and Chatzoglou, 2018). On this regard, it is worth noting that adequate training develops the digital skills necessary for an effective EHR implementation and promotes better reactions from stakeholders. On a similar note, another review on the barriers to health information exchange in low- and middle-income countries added that a lack of strong political will to promote an evidence-based decision-making culture might preclude successful implementations (Akhlaq el al., 2016).

Finally, it is worth mentioning the results of a review on the main challenges related to the implementation of IT tools in the health sector, particularly in low- and middle-income countries (Luna et al., 2014). This review confirmed that both the primary and

human-related barriers mentioned earlier have an effect. According to Luna et al. (2014), the most important barriers are resource and infrastructure limitations, the absence of nationwide digital health agendas, uncertainty about ethics and legal considerations (e.g., respect to privacy and security of the information), a lack of adherence to common interoperability standards, the limited presence of a workforce trained in health informatics, and poor regional collaboration.

The Way Ahead: Steps toward Successfully Implementing National EHR Systems in LAC

Currently, many governments in LAC have started or are planning to start digital transformation initiatives in the health sector, particularly around EHR systems. Based on the evidence available in the literature, we find that EHR systems offer a large potential to support the digital transformation of the health sector in LAC. A well-designed EHR system can improve the information available for policy making and the quality, continuity and efficiency of healthcare.

We see three options for countries considering EHR system adoption: (1) maintain the status quo with paper-based or siloed digital systems, (2) carry out poorly executed digital transformations, or (3) carry out well-designed and executed digital transformations.

Maintain the status quo

We view this as a non-option for those that want to take advantage of the future of healthcare. As mentioned before, the implementation of effective EHR systems is complex, so it is possible to opt to maintain the use of paper and existing limited electronic systems. However, this decision should be based on an adequate analysis of the costs involved. This includes the economic and time burdens for system administrators and frontline staff to document and digitize information for reporting purposes and the costs of maintaining a paper-based system. Additionally, the analysis should consider costs associated with duplication of procedures and medical errors and the opportunity costs associated with a lack of timely and quality information.

Poorly executed digital transformations and EHR system implementations

We admit that this is also a non-option. However, it is the default, costly choice of many EHR system implementers. According to a study of large firms in the US, only 9 percent of digital projects are entirely successful, 53 percent of projects were over budget, 68 percent were completed late, and only 42 percent of the

14 See Standish Group (2014).
15 The Inter-American Development Bank endorsed the Principles for Digital Development in 2018. For additional information, please refer to https://publications.iadb.org/en/approach-digital-transformation-guidelines-and-recommendations.

expected features were functional. These statistics do not mean that all EHR system implementations are doomed to failure, but it does mean that a strategic approach to the adoption of health technology is necessary. At the global level, many institutions are reviewing the way digital health is approached and have created guidelines, including the Principles for Digital Development and the Digital Investment Principles (Nelson et al., 2019).

Well-designed and executed digital transformations and EHR system implementations

When opting for this choice, countries need to be aware that the costs and processes involved go way beyond the purchase of an information system. and take a long time to mature. Countries that are serious about digital transformation know that true transformation comes from transforming processes of care and organizational culture, not just implementing new technologies. Somewhat paradoxically, the most important factor of a digital transformation strategy is not only digital.

In conclusion, based on available evidence, we make the following recommendations for countries considering making an investment in EHR systems:

Understand your current state

It is critical to understand the current state to set targets and measure progress. Various tools exist to measure digital health, including **methodologies and instruments** used in LAC developed by CETIC.BR and PAHO. Additionally, IDB has developed a National EHR System Maturity model that assesses five domains: Governance and leadership; Infrastructure; Infostructure; Health Information and Processes; and People and Culture (IDB, 2019). Lastly, it is important to involve the entire digital health ecosystem, including the public and private health sectors, academia, eGovernment social organizations and end users as part of the evaluation process.

Formally adopt a clear definition of an EHR system

Given the complexities of EHR definitions, it is critical to define what an EHR system is in your context, including its functions and contents. When defining these elements, it is critical to review the evidence. We have found that most evidence is linked to specific functionalities of an EHR system, such as a CDSS or CPOE.

Create the business case for EHR systems for your context

EHR systems are an important investment for governments. When considering this investment, it is important to take the following issues into account: the amount currently spent by the state on existing systems, including paper-based systems, and the time spent digitizing information and retrieving and storing paper charts; the expected future value for providers and citizens, including the reduction of errors and the increase in care coordination and satisfaction with care; the total cost of ownership, including maintenance, security, and change management, and the cost of no or bad information for both providers and decision makers as they manage health systems. Although improving the quality and efficiency of care is information intensive, the information can be transformational if used correctly.

Study and share your results

There is currently a chicken and egg problem: little research exists to support the implementation of EHR systems in LAC, and countries that do invest do not document their experiences. Countries should invest both in documenting their situation prior to and following the implementation and compare their results with those of other countries going through the same process to facilitate the creation of a greater body of knowledge (which would also assist with troubleshooting along the way).

Do not digitize bad processes

Using technology to perpetuate bad processes will just make digitally inefficient (and more expensive) processes. Evidence shows that the best EHR implementations have understood the business needs of service providers and adapted processes and technology to them. It is also important that the digital is subordinated to the country's health strategy, thus avoiding the view of technology as an end in itself (Carnicero, Fernandez and Rojas, 2014)

Design with the user

Efficiency is particularly at risk during the initial phase of implementing the EHR system because health care professionals have to adapt to a new workflow and workload. Resistance from health care professionals is common when projects are just starting, and when not adequately addressed, this resistance can lead to efficiency losses and even implementation failures. In order to avoid these issues, the implementation of change management strategies is critical. **Effective change management strategies include:** (a) the involvement of health care professionals in the EHR system's implementation process; (b) the identification of champions

among health care professionals; (c) support from management to counterbalance physicians' perspectives; (d) the assignment of specific personnel and resources to the EHR system's implementation; and (e) the development of training courses (Boonstra, Versluis and Vos, 2014). Evidence suggests that these strategies are essential to work efficiency and, more broadly, to implementation success.

You can learn more about change management from: Irresistible: How to manage change in digital health, IDB, 2019

Build an interdisciplinary team

Implementations should not depend on IT personnel alone. The team to implement an EHR should incorporate al the stakeholders involved in the process of delivering healthcare services from frontline workers, to managers, specialists and also the IT personnel (Carnicero, Fernandez and Rojas, 2014).

Intentionally plan your transformation and create a digital strategy

Successful implementation of EHR systems requires alignment of or buy-in from three major, interrelated components: (1) the mission, processes, and work culture of the organization; (2) the people who carry out this work; and (3) the tools and technologies (including hardware and software) that people use to do the work. Success requires the mission to be supported with continuously improving processes, motivated staff who support change, and the useful and usable technologies that the staff will actually use (Dowling, 1987).

To learn more about what LAC countries are doing and share resources and solutions that may be helpful to others, visit +Digital

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