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Implementing an Electronic Health Record System in a wide health care hospital in Latin America from a medical perspective

Implementación de un sistema de historia clínica electrónica en un amplio hospital de salud en América Latina desde una perspectiva médica

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ABSTRACT

Introduction: the implementation of Electronic Health Records (EHR) is one of the imperative technological changes in the present time. However, it is not just about contracting a service; implementation involves personalization, continuous adaptation, training of healthcare workers and feedback. The aim of this report is to highlight the implementation of the EHR in a Latin American setting. TecSalud is a prominent private hospital in Mexico. A team of physicians and technical engineers was responsible for implementing the process described in the workflow, which outlined the specific steps, challenges and opportunities for improvement. **Results:** we conducted a review of a cohort of 89 physicians, over an 8-month implementation period; the specialties included in the study were the emergency department, orthopedics, rehabilitation, internal medicine, and cardiology. We observed an improvement in the utilization of EHRs after training, especially in specialties that were hesitant to change. However, it's important to note that the improvement in the completion of the clinical file is not immediate, and there is even a decrease in usage before the improvement becomes evident. This is one of the first reports of implementation of EHRs in LA. **Conclusion:** effective implementation entails a series of constant changes that involve medical opinion, some specialties require more data in the EHR, which increases the complexity of its use. Training and feedback are key points for success. Our implementation system is an example of how to introduce a system and can be replicated by any health institution in need of a digital transformation.

Keywords: electronic health records, planning, implementing.

RESUMEN

Introducción: la implementación de la historia clínica electrónica (HCE) es uno de los cambios tecnológicos imperativos en la actualidad. Sin embargo, no se trata sólo de contratar un servicio; su implementación implica personalización, adaptación continua, formación del personal sanitario y feedback de los usuarios. El objetivo de este informe es resaltar la implementación de los sistemas de HCE en un entorno latinoamericano. TecSalud es un destacado hospital privado de México. Un equipo de médicos e ingenieros técnicos fue responsable

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de implementar el proceso descrito en el flujo de trabajo, que detallaba los pasos específicos, los desafíos y las oportunidades de mejora. **Resultados:** realizamos una revisión de una cohorte de 89 médicos, durante un período de implementación de ocho meses: las especialidades incluidas en el estudio fueron urgencias, ortopedia, rehabilitación, medicina interna y cardiología. Observamos una mejoría en la utilización de los HCE después de la formación, especialmente en especialidades que dudaban en cambiar. Sin embargo, es importante señalar que la mejora en la finalización del expediente clínico no es inmediata, e incluso se produce una disminución en el uso antes de que la mejor se hiciera evidente. Este es uno de los primeros informes sobre la implementación de HCE en nuestro hospital. **Conclusión:** la implementación efectiva conlleva una serie de cambios constantes que involucran la opinión médica, algunas especialidades requieren más datos en la HCE, lo que aumenta la complejidad de su uso. La formación y la retroalimentación son puntos clave para el éxito. Nuestro sistema de implementación es un ejemplo de cómo introducir un sistema y pueda ser replicado por cualquier institución de salud que necesite una transformación digital.

Palabras clave: historia clínica electrónica, planificación, implementación.

Abbreviations:

EHR = Electronic Health Records
ER = Emergency Room

INTRODUCTION

Electronic Health Records (EHR) are electronic records of patients' health-related data that can be created, collected, organized, and accessed by authorized healthcare professionals within a healthcare institution.¹

Electronic records have the potential to enhance the quality and efficiency of health care.² A comprehensive meta-analysis of the benefits of electronic record implementation in healthcare concluded that EHRs offer cost benefits and improve the accuracy of patient information. However, the authors also noted that more extensive and better-designed studies are needed to establish stronger scientific evidence regarding the benefits of EHRs in hospital care.^{3,4} Other benefits associated with EHR use are summarized on [Figure 1](#).

Despite the existence of numerous studies on EHRs, there are few publications that specifically focus on aspects of electronic records to guide their implementation and operation, especially in a Latin American setting.^{1,5}

The mere acquisition of an EHRs does not guarantee a positive perception among healthcare workers. Therefore, the implementation process is critical and must be viewed as an ongoing endeavor, spanning each phase from design and development to testing, and optimization.⁶ However, there is a vast amount of literature published on topics like EHRs, making it challenging for policymakers to stay current,^{7,8} potentially exacerbating the "how-to" gap.⁹

Despite the widely recognized benefits of EHRs, their full potential has not always realized, often due to challenges during the implementation process.¹⁰

Health care is recognized as an industry with a low acceptance of information technology.¹¹ There is limited data in the literature on the effectiveness of EHR implementation. As far as we know, there is currently limited information available on the use of information and communication technologies to promote health equity, particularly in Latin America and the Caribbean (LAC) settings.¹²

It is widely known that LAC experience a technological lag of between five and 20 years, depending on the geographical area; many health institutions are still in the process of migrating to EHRs.¹³ In LAC, the adoption of digital health tools is still in its early stages.¹⁴ Acquiring an electronic system should be accompanied by an implementation process and a management model that focuses on healthcare providers based on their organizational culture, context, and individualized resources.¹⁵ The aim of this report is to highlight the implementation system of EHRs in a Latin American setting.

MATERIAL AND METHODS

Setting: this case study presents the experience at Hospital Zambrano Hellion, located in the city of Monterrey, Mexico. Monterrey is the second largest metropolitan area in Mexico with an estimated population of 5.3 million and it is known for being an important industrial and financial city in Mexico. Hospital Zambrano Hellion is part of a world class private health system named TecSalud, which defines itself as an academic medical center integrated by a medical school (Tecnologico de Monterrey), medical residencies and services for diagnosis and therapeutics.

In terms of dimensions, the hospital has 90 active hospital beds and 59 non-active beds [including intensive care unit (UCI), operating room (OR) and emergencies (ER)] and 172 consulting rooms. The hospital offers services for six active operating rooms, a room for endoscopic procedures and a hemodynamics room. In terms of productivity, the hospital has a daily average occupancy of 95 patients.

The population of doctors enrolled in the institution is around 3,000 including 90 medical staff personnel. For the purpose of this study, aside from the staff members, we include a cohort of 89 doctors that are part of an academic/research program from a variety of specialties.

Organizational factors: in November 2022, chaired by the medical director of the institution (Sánchez-Rodríguez G), a multidisciplinary group formed by a biomedical engineer (Lozano-Ulloa AG), a medical doctor with technical knowledge on Electronic Medical Record (Salas-Lumbreras PL), a pediatrician with connected relations with the medical group (Gonzalez-Camid E), and a last year med student as

support (Serna-Treviño F), worked in the planning and implementation project. Since the beginning, the team collaborated with the Information technology and Nurse departments in the upgrade and implementation of the EHR at Hospital Zambrano Hellion. It should be noted that this multidisciplinary team carried out the implementation as part of their work, however, they did not dedicate themselves exclusively to this project.

Workflow: before initiating the implementation process, we conducted a comprehensive assessment of the features and capabilities of the EHR platform utilized by our institution. This evaluation was prompted by a previous unsuccessful attempt at full implementation, which had resulted in the medical group abandoning the EHR platform for more than eight years. During this hiatus, the only progress in digital healthcare had been driven by the initiatives of the nursing department, with a usage rate exceeding 90%. As a multidisciplinary team, we identified a series of improvements and subsequently engaged in discussions with the EHR provider to manage the project.

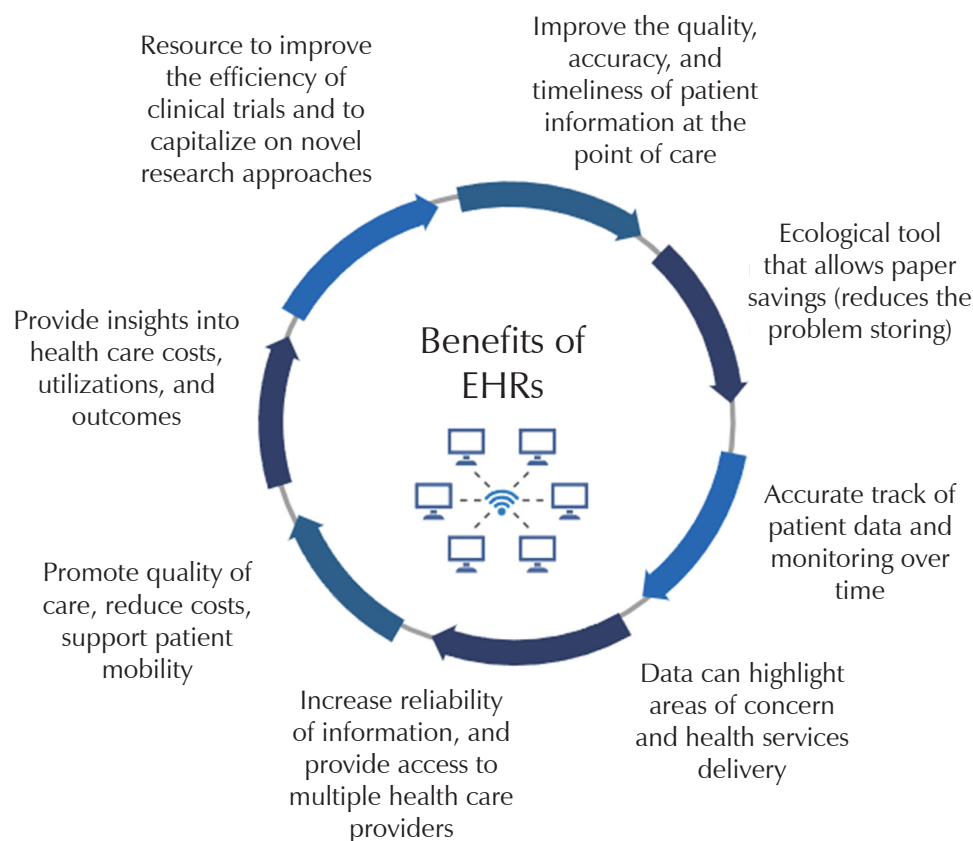


Figure 1:

Benefits of EHRs. The figure was created by Microsoft Corporation. (1996). Visual FoxPro (5.0).⁵

Our first step to facilitate the transition from physical to electronic records was to create a standardized format for clinical records. This standardization aimed to streamline the migration to electronic records and reduce the risk of documentation errors. From the project's inception, the EHR provider displayed an open attitude and willingness to collaborate throughout the implementation process.

To address challenges related to medical record documentation, we collaborated with the provider to optimize the user experience by facilitating connections between various medical documents. This included the option to import relevant information between clinical records, ultimately enhancing the quality of patient information from a collaborative perspective.

During the initial phase of implementation, we concentrated our efforts on engaging doctors who had prior experience using the existing EHR system. We selected this group based on statistics and usage percentages obtained through the audit tool software of the EHR, as well as through manual data collection (Figure 2).

Technological factors: for the purpose of this study, we included an electronic medical record with a software that is in Spanish language and includes integrations with the major diagnosis services of the hospital and with the enterprise resource planning for the functions of account and health management. There is hardware available for the use of the EHR around all the major clinical areas, including Emergency Room (ER) and in the majority of consulting rooms.

Survey instrument: a structured questionnaire containing 4 key questions was built, with the aim of knowing the opinion of the participating doctors and taking advantage of their observations to make the necessary changes within the platform and facilitate its use.

The four questions included in the questionnaire were:

1. I consider that the EHR has a difficulty level:
 - a) High
 - b) Medium
 - c) Low
2. At the end of the training, I consider that:
 - a) I can make electronic documents without help.
 - b) I need more training to be able to use it correctly.

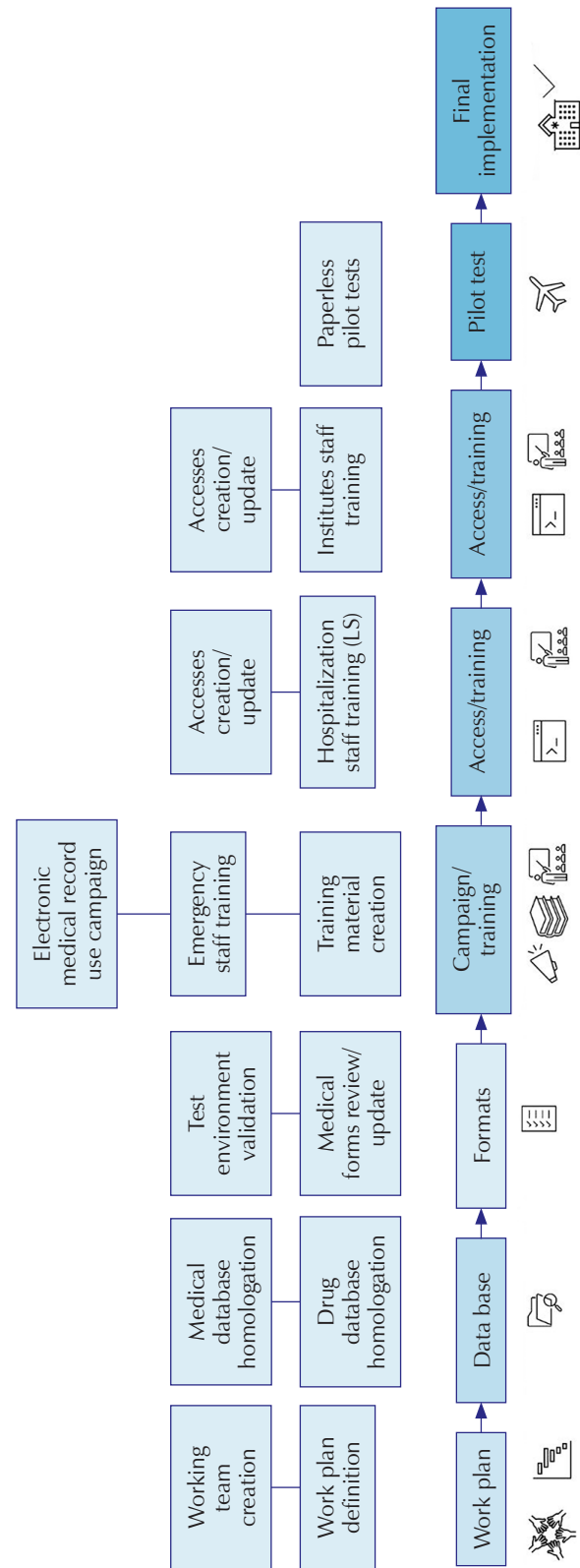


Figure 2: Workflow of EHRs modifications leading to final implementation. Figure made by Lozano-Ulloa AG.

- c) I do not consider myself ready to start using it in my daily practice.
3. I would like to support other colleagues as a facilitator:
- Yes
 - No
4. Do you consider that what you have learned will facilitate your daily work?
- Yes
 - No
 - Depends on the situation. Specify: _____

Training: before initiating the training program, we established a focus group comprising medical staff to gather feedback from daily users of the EHR. Based on this feedback, we developed a training program with the aim of enhancing the software's usability and user experience for both doctors and clinical personnel. The training sessions were conducted weekly, each lasting one hour, and were open to all doctors, as directed by the medical director. During these sessions, we focused on a single foundational clinical document because the software's behavior is consistent across various medical records, eliminating the need for extensive training on new documents.

These sessions were led by the medical doctor overseeing the implementation, with support from team members who assisted participants during the sessions. The training approach emphasized collaboration among clinical peers and was conducted in different meeting rooms within the hospital. A "control patient" was used to demonstrate the software's functionalities and proper documentation processes.

Support: to provide ongoing support, users were given access to a 30-minute video summarizing the training session to address doubts and reinforce educational content. Additionally, the implementation team offered support during working hours through various online tools, including online meetings, email, phone calls, and phone messages. For technical issues, doctors had access to an exclusive phone extension with direct contact with the informatics department.

RESULTS

The primary objective of this implementation was to transition and unify health records into a fully electronic system, integrating each hospital

area progressively. Prior to the implementation, the hospital operated with a hybrid system, using electronic systems to support paper-based medical records or different EHRs based on the specific needs of each medical specialty.

We enrolled a total of 451 doctors in the implementation process. We initially focused on the ER due to its ease of access to physicians. Unlike other specialties, ER physicians are direct employees of the hospital. Subsequently, we extended the implementation to orthopedics, rehabilitation, internal medicine, and cardiology. For this study, our population included a cohort of 89 physicians (20%), while the rest of the doctors spanned multiple specialties. More complex areas, such as the intensive care unit, operating rooms, and pediatrics, are still pending implementation.

The distribution of the population was as follows: ER 28% (n = 25), orthopedics 26.9% (n = 24), rehabilitation 10.1% (n = 9), internal medicine 13.4% (n = 12), and cardiology 21.3% (n = 19). The multidisciplinary team worked diligently for eight months on the EHR implementation.

Technological factors: we utilized the available software without acquiring additional tools. In the selected specialties, we maintained a device-to-doctor ratio of 1:1, while in the ER, the ratio was 1:8. However, we later realized that the availability of devices for accessing the system was insufficient for a broader-scale implementation.

Technical issues: after analyzing the EHR software, we identified several limitations. The software is only compatible with Windows and MAC PCs and is not accessible on mobile devices such as tablets or cellphones. It also requires the installation of additional software and plug-ins. Moreover, access to the platform was restricted to the hospital's internal network, limiting accessibility and usability.

From a software perspective, the documentation process can be frustrating for some users. It demands a certain level of prior knowledge of the platform and involves a multi-window registration, resulting in a higher number of mouse movements and clicks to access the desired tabs for documentation. During training sessions and the EHR implementation, we encountered unexpected software crashes leading to data loss and document-saving delays.

Barriers: during the implementation, we faced several barriers that hindered project development. Many doctors, likely due to a previous failed

implementation attempt, displayed a lack of enthusiasm for participating in training sessions.

We also observed delays in the provider's response time for developing functionalities and making changes to clinical documentation. Delivery dates often extended weeks beyond the planned timeline, complicating project management. Additionally, there was a shortage of equipment (computers) in common areas like the ER, in contrast to specialty areas where each person had their computer. To address this, we recommend increasing the number of devices per person in common areas.

Emergency room: we observed an improvement in the completion rates of EHRs, especially following initial training sessions in November and December. In the ER, we evaluated four different components of the medical note - "Current Patient Visit" (entry note, history of the current illness, physical examination, and allergies and idiosyncratic reactions), with improvement rates ranging from 81 to 96%. Our analysis revealed a relative risk of 2.5 with a 95% confidence interval of (2.0-3.0), indicating that the tutoring intervention increased the probability of using the electronic platform by 1.5 times in the case of the ER ([Figure 3](#)).

It is worth mentioning that training in the use of the platform was performed with the Emergency Room staff

during November-December 2022, and later continued from January 2023 with the specialties of orthopedics, rehabilitation, internal medicine and cardiology.

It is important to mention that we first evaluated the progress of the "evolution (progress) note and current patient visit", since these were the first notes updated during February 2023.

In the case of the "evolution (progress) note", when evaluating the medical specialties, we noticed that there was a percentage of completion of 58% before the training. We observed a decrease from 21 percentage points to 36% after the training and one month later the percentage of use rose to more than 90% in all specialties, which confirms that there is a resistance to the initial change viewed by a reduction of use prior to a sustained improvement ([Figure 4](#)). However, in the case of vital signs recording, we noticed an improvement only in certain specialties and the mentoring did not generate important changes in specialties such as orthopedics and rehabilitation ([Figure 5](#)). In the case of diagnosis, we did not find major changes either, despite the fact that the percentage of completion of this data was quite good prior to mentoring ([Figure 6](#)). Therefore, we conclude that the training generates greater impact on the recording of notes than on vital signs and diagnosis; future modifications should be made

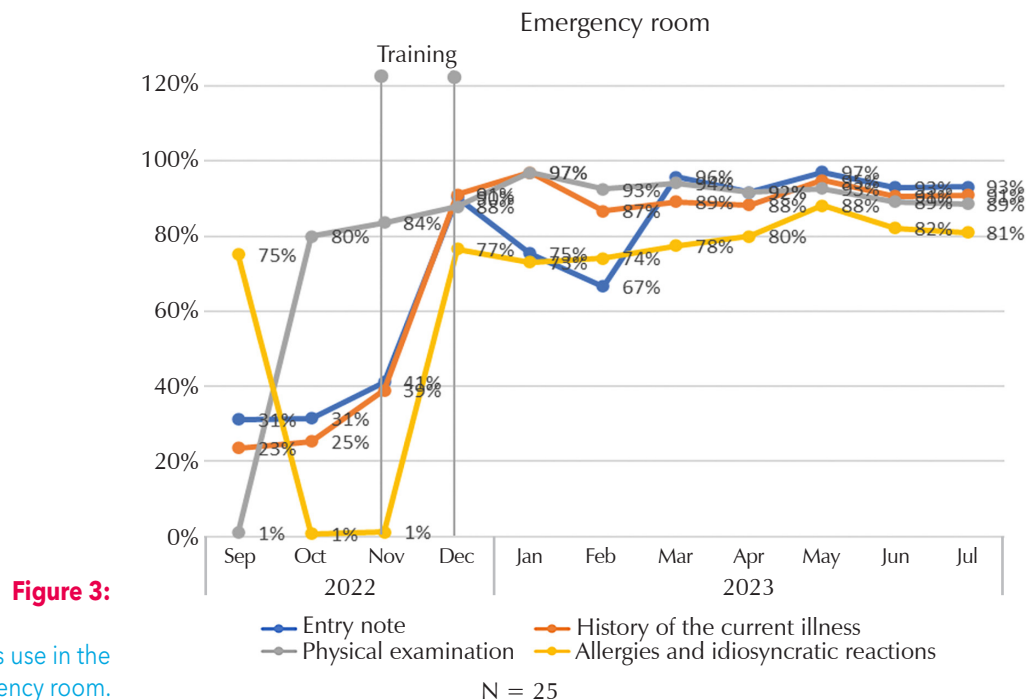
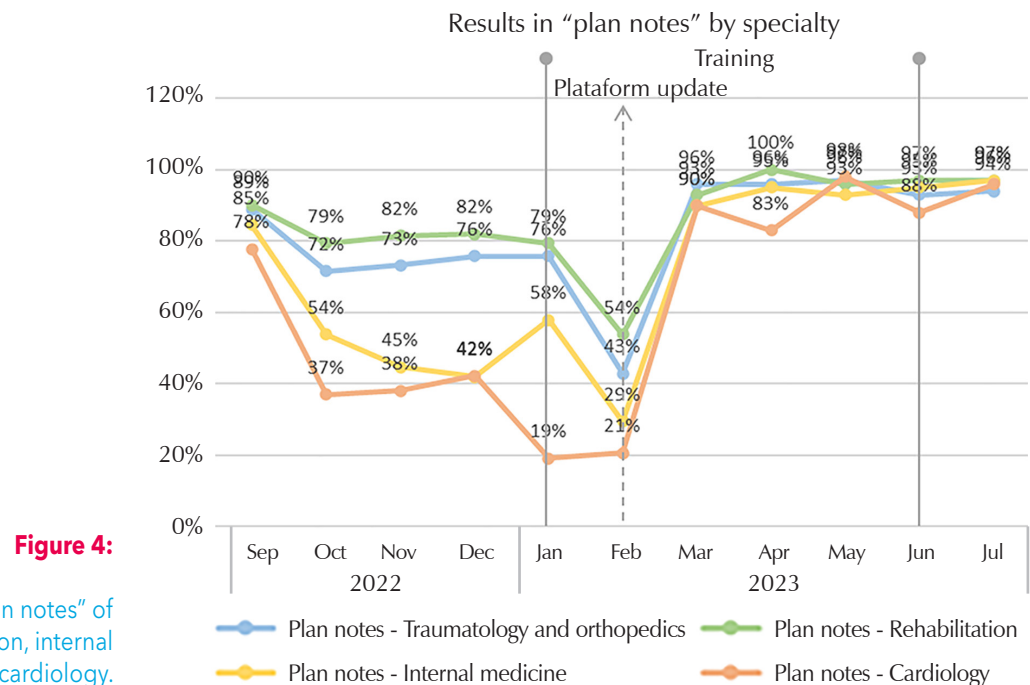


Figure 3:

Trends in EHRs use in the emergency room.



in the area of vital signs in order to generate a greater impact (Figures 7-10).

As mentioned above, we noticed that as of November 2022, the ER physicians showed an important increase in their percentage of completion results in the electronic medical record (33 to 82%) (Figure 3). Conversely, it is noteworthy that in the same month of February 2023, all medical specialties demonstrated substantial improvements in their completion rates across various elements. This positive trend can be attributed to the aforementioned changes and updates in the note-taking process, which now streamline the file completion process, enhance data import procedures, and optimize overall platform navigation (Figure 4).

This underscores the significance of initially identifying specific areas of focus, followed by the selection of medical notes for digitization. Ultimately, providing the team with comprehensive training on platform utilization becomes pivotal to this process.

DISCUSSION

Implementing EHRs in a healthcare institute involves a series of steps that encompass the complexity of incorporating a substantial number of doctors from various specialties, enabling the effective

management of medical information across the entire healthcare system.

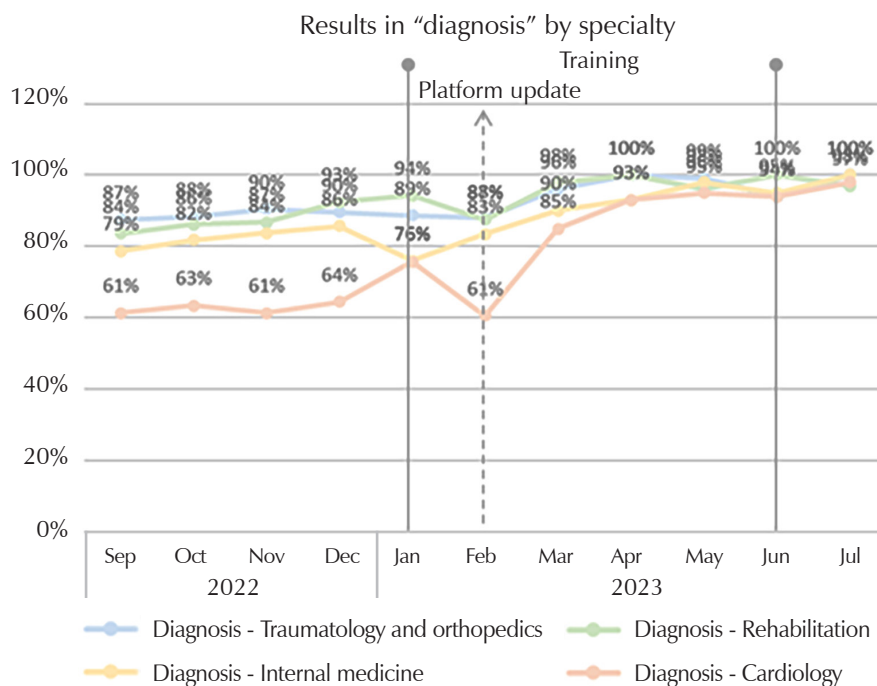
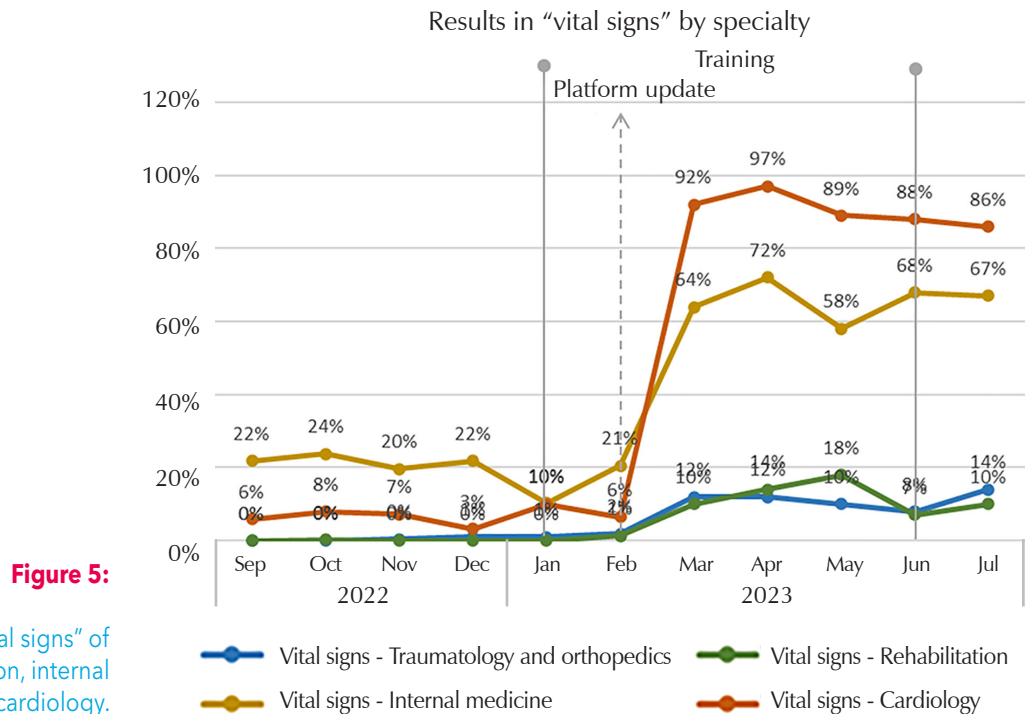
In our report, user satisfaction increased as the EHRs were customized and adapted to the needs of the hospital, the greater the changes, the greater the satisfaction. This is consistent with what has been reported in the literature worldwide; health institutes that have implemented EHRs have reported a temporary increase in errors, highlighting the importance of a proper usability evaluation before implementation, in order to allocate resources and successfully organize healthcare professionals training.

Some limitations of our study include the fact that we only included a subset of specialties. This limitation arises from the phased approach to EHR implementation, which progresses through different hospital areas. It remains necessary to continue the implementation process with the goal of encompassing all medical specialties in the near future.

Another limitation is our inability to control some factors associated with EHRs use, such as physician age, comfort with technology, availability of time with doctors, motivation and resistance to change. It's worth noting that the EHRs implementation team comprises young members with an average age of 30 years. This aspect is significant because previous studies have demonstrated that younger individuals

tend to have a greater aptitude for technology usage. This finding holds relevance as it suggests that knowledge transfer from younger to older generations can be facilitated.¹⁶

According to the literature, one of the most critical factors leading to the failure of EHR system implementations is the absence of adequate support and a negative reaction to change.¹⁷



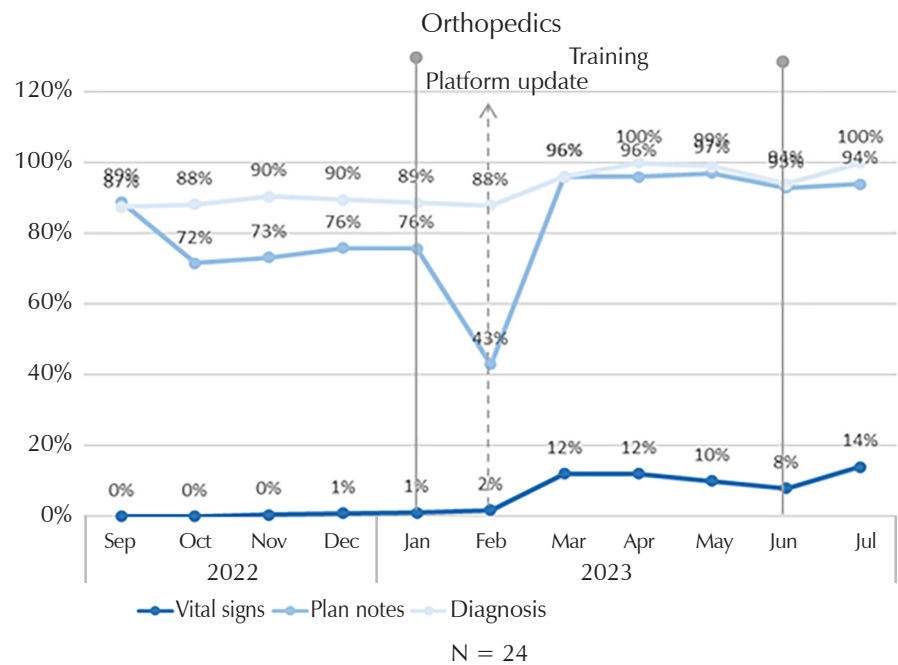


Figure 7:

Trends in orthopedics.

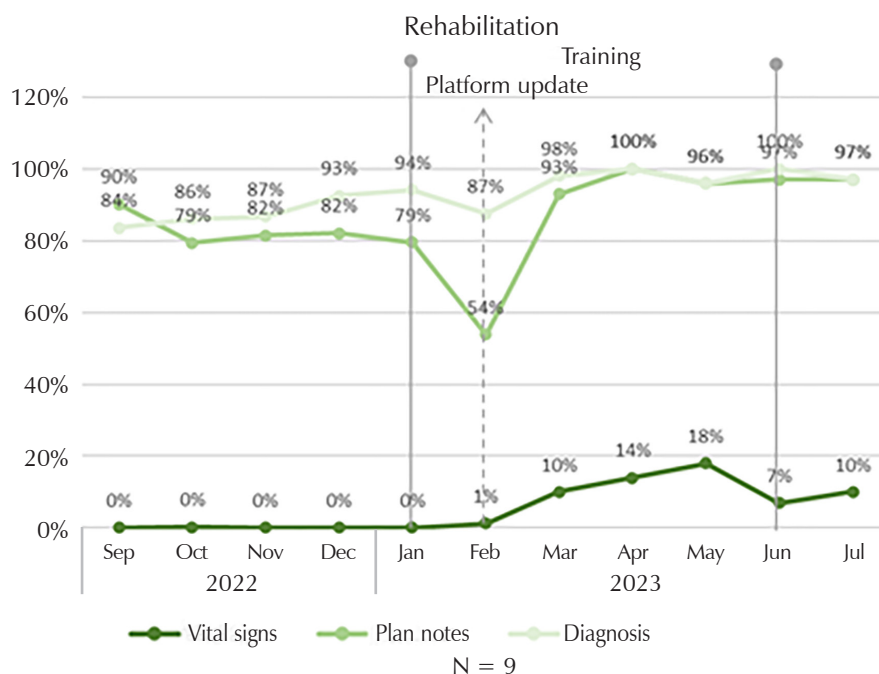


Figure 8:

Trends in rehabilitation.

Our implementation started by the emergency room, considering that the emergency department is the first contact with the patient, where a large

number of specialty consultations is required (admission, seeking opinion, special procedures, transfer of care, and outpatient referrals)¹⁸ and where

the optimization of times and reduction of errors is imperative. Although we note that the emergency service was one of the departments with the largest number of trained physicians and where follow-

up in the use of the EHRs is best observed, we believe that it is due to the fact that the emergency physicians are direct employees of the hospital and therefore training is part of their daily work, unlike

Figure 9:

Trends in internal medicine.

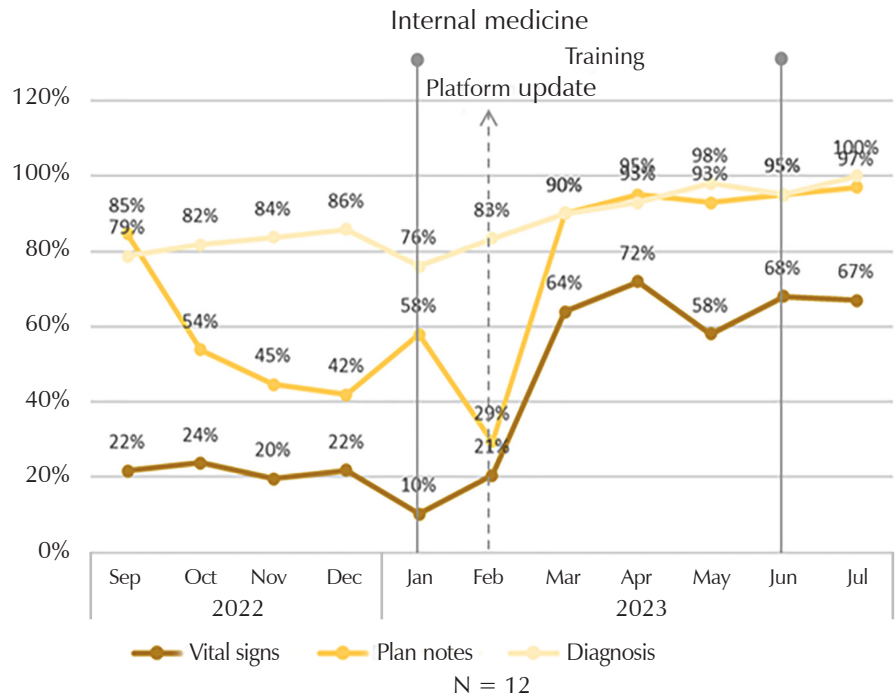
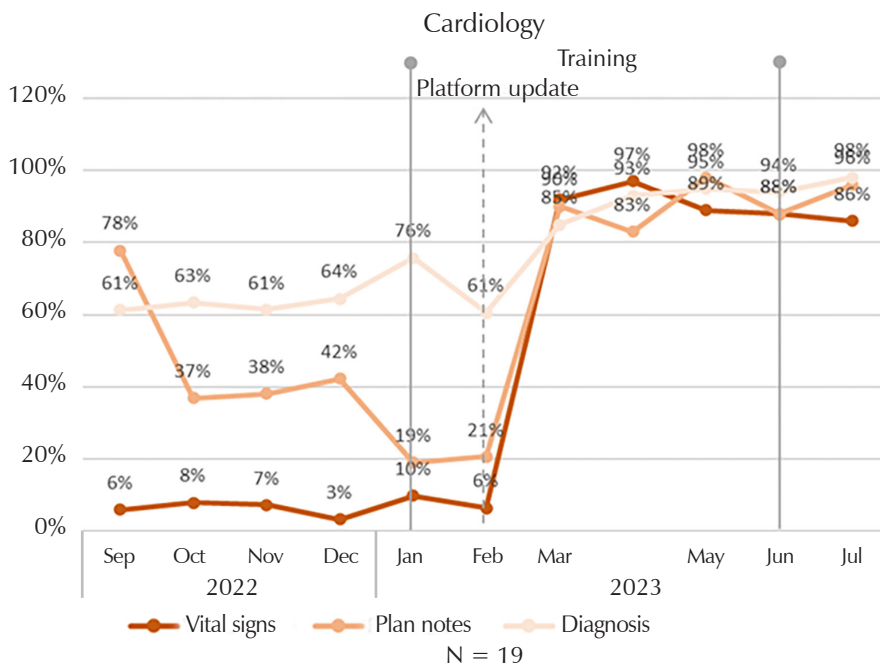


Figure 10:

Trends in cardiology.



other services where private doctors are not directly employed by the hospital.

One of the services that achieved adequate adherence to the use of EHRs was orthopedics and rehabilitation. The authors consider that this may be linked to the objectivity of their notes, unlike an intensive care or pediatric note with more items to cover. Similar to what was observed in our center, in a study of a thousand patients carried out in Korea where adherence to the use of the electronic record was evaluated according to the medical specialty, it was found that non-surgical specialties spent more time using the record since they required the use of multiple tabs due to the complexity of the specialty (internal medicine, pediatrics and gynecology) compared to the surgical group (surgery, orthopedics, otorhinolaryngology) who used few tabs and therefore their time in the file was shorter and they had more attached to it.¹⁹ Authors in United States facilities reported that orthopedics and cardiology were the most likely to adopt EHRs.²⁰

Other authors found that psychiatrists, dermatologists, pediatricians, ophthalmologists, and general surgeons were less likely to adopt EHRs (compared with family medicine/general practitioners);²¹ these authors suggest that this could be explained from different insights; Cardiologists and neurologists regularly use digital analysis of physiologic signals (electrocardiogram and electroencephalogram) in patient care, suggesting they may be more comfortable integrating computers into their practices compared with other specialists. For specialists with lower prevalence of EHR adoption (psychiatrists, ophthalmologists, dermatologists, pediatricians, and general surgeons), there may be specialty-specific barriers preventing adoption. These specialties have specific privacy, workflow, and information needs that may set them apart from other specialists. Ophthalmology and dermatology both have high patient volume, require the integration of specialized images and handwritten drawings and typically include both a busy outpatient practice and surgical procedures. Pediatricians have many specific information needs that differ from those of physicians who care for adults, including immunization management, documentation of growth, and weight and age-based dosing.

In a survey including 208 Norwegian physicians,²² 72% of the physicians reported interrupted or

delayed work at least once a week because of technical issues (delays or crashes) and 53% of the physicians indicated that the EHR is difficult to use and adds to their workload.

Regarding the vital signs registration, we note that some specialties take vital signs more into account, such as internal medicine and cardiology and, of course, the emergency room. This appears not so relevant for specialties such as orthopedics compared to a low percentage of registration of vital signs. When compared to the literature, there have been studies that show that surgical specialties tend to register fewer vital signs in the EHRs compared to other specialties. Likewise, we believe that in this particular software, the recording of vital signs is not intuitive and takes longer to record, which could explain why it was not filled out. A 2013 study²³ at John Hopkins found that vital signs are not regularly recorded and that vital sign measurement accuracy is low. There is a paucity of evidence regarding the utility of vital sign measurement in outpatient settings despite mandatory reporting policies.

In our hospital, a satisfaction survey regarding the use of electronic records was conducted. Each response was carefully considered to enhance the system and prevent physician burnout, which is a significant concern. Meta-analysis studies have highlighted that EHR-related burnout can be attributed to various factors, including documentation and clerical burdens, complex usability, electronic messaging and inbox management, cognitive load, and time demands.²⁴

An observation from our study was the evolution of satisfaction survey results as improvements were introduced, accompanied by an increasing familiarity with the use of the electronic record. Several studies have noted that the initial use of an EHR system can be overwhelming for most users, but once a level of comfort is attained, it is generally well-accepted.²⁵

In consideration of practices to be replicated in future EHR implementation processes, we sought to assess the effectiveness of various strategies. Key aspects that were executed effectively, often considered as best practices, included the collaboration of a multidisciplinary team, efficient utilization of available resources, fostering teamwork, embracing openness to change, and actively involving users in the enhancement process.

One noteworthy aspect that the team believed could enhance future implementations is the

implementation of a marketing or information campaign targeting the doctors who will undergo training.

While current technology steers us toward electronic record-keeping, emerging modalities such as speech recognition, medical scribes, and pre-made EHR templates are increasingly employed to streamline documentation processes, reduce charting time, and allocate more time for direct patient care. It is imperative that we acknowledge and integrate these advancements as we continue to evolve EHR technology.²⁶

A key recommendation for healthcare industry managers is to adopt specific practices that facilitate the digital transformation process within their organizations. It's essential to recognize that this transformation extends beyond the mere adoption of information technologies; it encompasses effective management of the associated organizational change.¹¹

CONCLUSION

In conclusion, digital transformation is reshaping the healthcare industry. Latin America faces a scarcity of information regarding the use of EHRs as tools for promoting health equity. The implementation of EHRs stands as one of the most imperative technological changes in the present era. However, it transcends mere service acquisition; it demands personalization, continuous adaptation, healthcare worker training, user feedback integration, and the dedicated collaboration of multidisciplinary teams from engineering and medicine for continuous improvement.

Certain specialties necessitate a more comprehensive incorporation of data within EHRs, elevating the complexity of their usage. The importance of meticulous implementation planning, coupled with ongoing adaptation in response to user perceptions, cannot be overstated as it encourages EHR utilization. Feedback data gleaned from physicians' usage of EHRs offers valuable insights for system enhancement. The evolution of EHRs entails a continual improvement process that aligns with the evolving needs of the population, the healthcare team, and the response to emerging health crises like the recent pandemic. This perpetual refinement enables physicians to allocate less time to computers and more time to patient care. The implementation

model we've described can serve as a blueprint for any Latin American institution embarking on the path to electronic record migration.

Since this study does not involve human participants, human material, or human data, informed consent was not required. It was approved by the ethical committee.

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