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REVISIÓN SISTEMÁTICA

Electronic medical record and its impact on health care and management. A systematic review between the years 2013 - 2023

La historia clínica electrónica y su impacto en la atención y gestión sanitaria. Una revisión sistemática entre los años 2013 - 2023

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ABSTRACT

The adoption of Electronic Health Records (EHR) has revolutionized the landscape of healthcare and healthcare management in recent decades. These technological systems have been the subject of extensive interest and study to understand their impact on improving patient care and efficiency in health management. For this reason, this study proposes to evaluate the impact of the use of electronic medical records on health care and management. In addition, the study includes a systematic review of the literature of research carried out between 2013 and 2023 on the use of the Electronic Health Record (EHR) focused on patient care and health management. The PICO methodology was used to formulate the search equation in the Scopus database. To select the studies, the PRISMA methodology was used through 3 stages: identification, screening, and inclusion, obtaining a total of 17 articles for review, according to inclusion and exclusion eligibility criteria. At the beginning of the systematic search, 56400 studies were found, 5220 were related to health care, 244 researchers work carried out between 2013 and 2023 focused on health management. Also, 17 studies obtained at the end of the third search stage, 42,11 % indicated that the EHR facilitates medical care, 21,05 % indicated that it provides better safety and greater patient satisfaction. On the other hand, 36,36 % and 45,45 % mentioned that with the EHR there is a good quality of care and better clinical management, respectively, compared to the use of paper medical records. In conclusion, the EHR offers benefits in medical care and facilitates decision making at the health management level. Its interoperability means that clinical management is integrated with all other medical systems to provide quality care, despite certain limitations that persist in the health field.

Keyword: EHR; Self-Care; EMRs; Blockchain; Medical Informatics.

RESUMEN

La adopción de las historias clínicas electrónicas (HCE) ha revolucionado el panorama de la atención sanitaria y la gestión de la salud en las últimas décadas. Estos sistemas tecnológicos han sido objeto

de amplio interés y estudio para conocer su impacto en la mejora de la atención al paciente y la eficiencia en la gestión sanitaria. Por ello, este estudio se propone evaluar el impacto del uso de la historia clínica electrónica en la atención y gestión sanitaria. Además, el estudio incluye una revisión sistemática de la literatura de investigaciones realizadas entre 2013 y 2023 sobre el uso de la Historia Clínica Electrónica (HCE) centrada en la atención al paciente y la gestión sanitaria. Se utilizó la metodología PICO para formular la ecuación de búsqueda en la base de datos Scopus. Para la selección de los estudios se utilizó la metodología PRISMA a través de 3 etapas: identificación, cribado e inclusión, obteniendo un total de 17 artículos para revisión, según criterios de elegibilidad de inclusión y exclusión. Al inicio de la búsqueda sistemática se encontraron 56400 estudios, 5220 estaban relacionados con la atención sanitaria, 244 trabajos de investigadores realizados entre 2013 y 2023 enfocados a la gestión sanitaria. Asimismo, 17 estudios obtenidos al final de la tercera etapa de búsqueda, el 42,11 % indicó que la HCE facilita la atención médica, el 21,05 % indicó que proporciona una mejor seguridad y una mayor satisfacción del paciente. Por otro lado, el 36,36 % y el 45,45 % mencionaron que con la HCE hay una buena calidad asistencial y una mejor gestión clínica, respectivamente, en comparación con el uso de historias clínicas en papel. En conclusión, la HCE ofrece beneficios en la atención médica y facilita la toma de decisiones a nivel de gestión sanitaria. Su interoperabilidad hace que la gestión clínica se integre con el resto de los sistemas médicos para proporcionar una asistencia de calidad, a pesar de ciertas limitaciones que persisten en el ámbito sanitario.

Palabras clave: HCE; Autocuidado; EMRs; Blockchain; Informática Médica.

INTRODUCTION

The International Organization for Standardization (ISO) defines an electronic health record as an electronic health record (EHR) that integrates a person's relevant information about their health and medical care that allows them to be connected virtually and is shared and interoperable within health facilities. This registry optimizes patient care and facilitates communication between the entire multidisciplinary health team that is caring for the user, apart from being the main source of data and information for audit processes, research, or medical-legal issues.[1,2,3]

In the 20th century, medical care revolved around the medical professional, who diagnosed and treated patients in an office or at home on paper. However, in the early 1990s, electronic health records were introduced in the United States as a result of the technological advances of the time, which made it possible to detect the shortcomings of these manually written medical records. Then the increase in the demand for medical care during the COVID-19 pandemic that exposed the huge gap between the volume of care and the capacity of health facilities to exchange users' clinical data, at least at the intramural level. Also, the handling of these large amounts of data has prompted the creation or implementation of more sophisticated methods to protect the security and privacy of patients.[4]

The adoption of electronic health record systems has increased in all countries of the world and adoption rates are higher in developed countries than in developing countries, where adoption rates have grown slowly and the usefulness of these systems is focused on administrative issues rather than clinical care. In the United States, 58,9 % of hospitals were using EHRs in 2014, and in 2017, 80,5 % of facilities used this type of record. Furthermore, Australia and New Zealand have achieved adoption rates in general medical practices with more than 90 % and 100 %, respectively.[5] In contrast, low- and middle-income countries such as Kenya, Mozambique, Ghana, Tanzania, Uganda, among others, EHR use has occurred only in national systems.[6,7,8,9]

Due to the constant modernization and digitization of health care record systems and the shortcomings of the Peruvian health care system in the use of electronic medical records, this systematic review

proposes to describe generally the implementation of an electronic medical record system in the clinical care of patients with security and protection measures that safeguard the confidentiality of data in the interoperability process.[10,11]

It is important to empower the patient in the promotion of self-care through the use of an HRE because there is scientific evidence of self-management that generates and improves their health outcomes in the face of certain chronic conditions. In addition, attitudinal, individual, demographic and capacity factors related to health or the use of HRE decrease adoption rates; however, it is necessary to train and teach health literacy to all patients who, due to lack of knowledge, are reluctant to continue their care through information technology.

Therefore, the objective of the present systematic review is to evaluate the impact of the use of the electronic health record in health care management with security and protection measures that safeguard the confidentiality of the data in the interoperability process to provide modern, integrated and quality care to users receiving care in outpatient, emergency and hospitalization services.

METHODS

A systematic search was carried out in the Scopus database, according to the following equation:

Inclusion criteria

- CI1. Studies addressing the use of an electronic medical record system in patient care.
- CI2. Studies that explain the limitations of the use of traditional medical records in patient care.
- CI3. Studies that measure the impact of the use of electronic and traditional medical records.
- CI4. Studies that measure the impact of the use of electronic and traditional medical records on hospital management.
- CI5. Studies published between 2013 and 2023.

Exclusion criteria

- CE1. Studies developed in non-hospital settings.
- CE2. Research not focused on hospital management.
- CE3. Publications that do not correspond to original articles.
- CE4. Documents prior to 2013.

Table 1. PICO

Item	Keywords
P(Population/Problem)	patients OR "health professional" OR "health personnel"
I (Intervention)	ehr OR "electronic health record" OR "electronic medical record" OR "digital health" OR ehealth OR "digital recording" OR "medical information" OR "healthcare information system"
C (Comparation)	"traditional health record" OR "traditional medical record" OR "traditional paper"
O (Results)	"health management" OR "hospital management" OR impact OR benefits OR improvements OR implications OR effects

The scientific literature search process was carried out in 3 stages: identification, screening and inclusion, and 17 selected studies were obtained from the Scopus database for the systematic review of the present research.[12,13,14,15]

Description of the considered selection logic (PRISMA)

First stage: Identification

To identify the total number of studies related to the research topic, the following keyword was used: "Electronic health records"

Second stage: Screening

To find specific studies related to the electronic medical record with health management or its impact, the following keywords were used:

"patients" OR "health professional" AND "electronic health records" AND "health management" OR "impact"

To select only those studies related to the electronic medical record and health management, the following keywords were used:

"patients" OR "health professional" AND "electronic health records" AND "health management"

For the application of inclusion criteria, filters such as the year of publication of the articles were used and the review of titles and abstracts was carried out.

A total of 17 publications were included for systematic review.

RESULTS AND DISCUSSION

The results presented include the review by stages, according to the PICO questions formulated, which are the objectives of this research. In addition, aspects such as interoperability, ease of medical care, cost-effectiveness analysis, safety and patient satisfaction involved in health care are included. In addition, clinical management, protection of patient information and, above all, the quality of care received are emphasized in health management.[16,17,18]

Results of document review in the first stage

table 2 and figure 2 show the number of documents published on electronic medical records between the years 2020-2023. Of the 56 400 articles found in the first stage review, the first 20 000 documents were exported to Scopus.

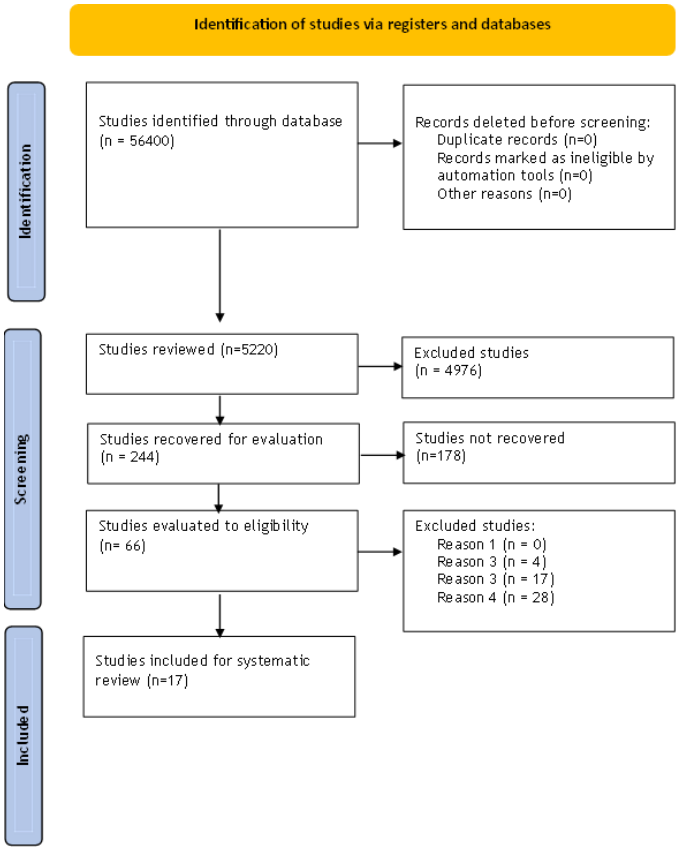

Figure 1. PRISMA flowchart graphically reflecting the process

Table 2. Published documents on electronic medical records		
Year	**N°. documents**	**% annual**
2020	2509	12,55
2021	6689	33,45
2022	7518	37,59
2023	3284	16,42
Total	20000	100,00

Results of document review in the second stage

table 3 and figure 3 show the number of documents published on electronic medical records, their application by health professionals and their impact on health management between the years 2000-2023. A total of 5220 articles were found according to the Scopus database.[19,20,21,22]

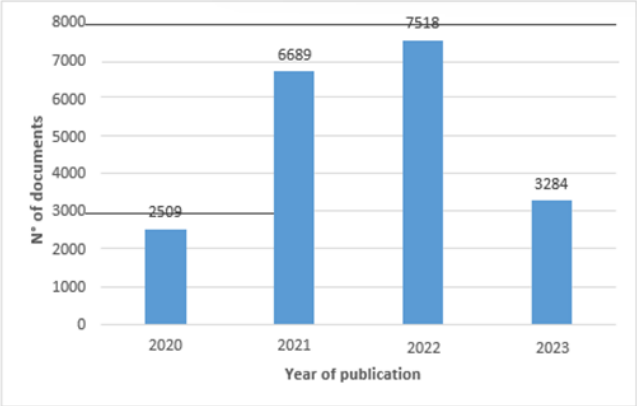

Figure 2. Documents published per year.

Table 3. Published documents on electronic medical records and health care		
Year	**N°. documents**	**% annual**
2000	1	0,02
2001	1	0,02
2002	2	0,04
2003	1	0,02
2004	11	0,21
2005	7	0,13
2006	21	0,40
2007	28	0,54
2008	21	0,40
2009	44	0,84
2010	63	1,21
2011	113	2,16
2012	142	2,72
2013	187	3,58
2014	224	4,29
2015	281	5,38
2016	295	5,65
2017	422	8,08
2018	381	7,30
2019	495	9,48
2020	553	10,59

2021	733	14,04
2022	833	15,96
2023	361	6,92
Total	5220	100,00

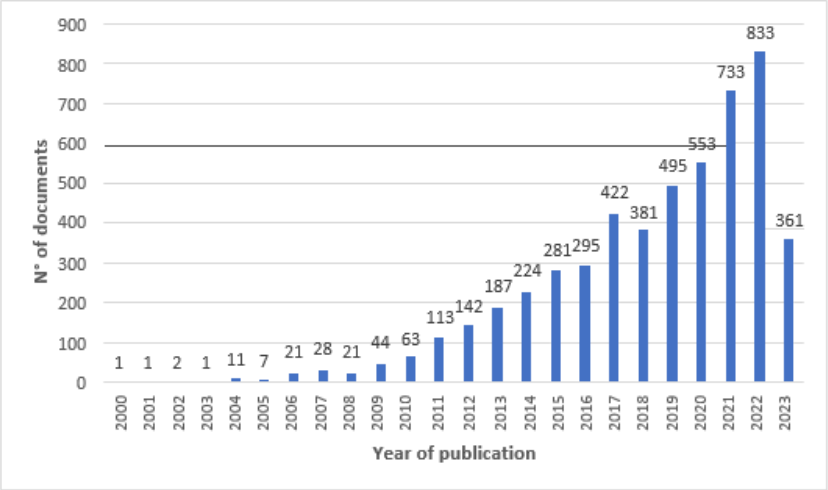

Figure 3. Documents published per year

By limiting the search to reviews on electronic medical records and health management, 244 documents published in Scopus were obtained, as shown below in table 4 and figure 4.

Table 4. Published documents on electronic medical records and health management

Year	N°. documents	% annual
2002	1	0,41
2004	1	0,41
2006	3	1,23
2007	2	0,82
2008	1	0,41
2009	1	0,41
2010	4	1,64
2011	1	0,41
2012	8	3,28
2013	7	2,87
2014	15	6,15
2015	12	4,92
2016	15	6,15
2017	26	10,66
2018	19	7,79
2019	27	11,07
2020	31	12,70
2021	28	11,48
2022	32	13,11
2023	10	4,10
Total	244	100,00

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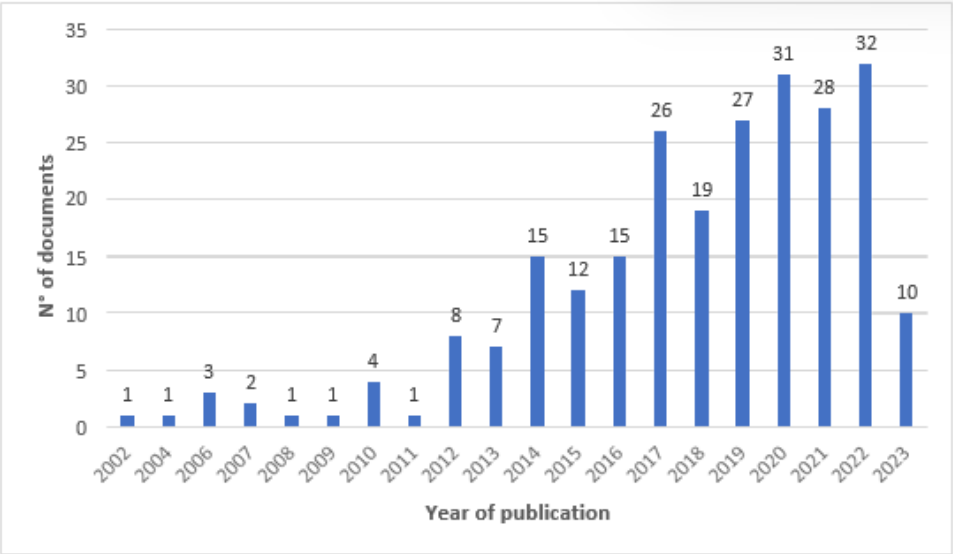

Figure 4. Documents published per year

Results of document review in the third stage

Finally, the search equation was applied according to the PICO methodology, the review of titles and abstracts and 17 articles published in Scopus between 2013-2023 were obtained, according to the chosen study period as shown in table 5 and figure 5.[23,24,25,26]

Table 5. Published documents on electronic medical records and health management

Year	N°. documents	% annual
2013	3	17,65
2014	2	11,76
2015	1	5,88
2017	2	11,76
2018	1	5,88
2019	2	11,76
2020	5	29,41
2021	1	5,88
General total	17	100,00

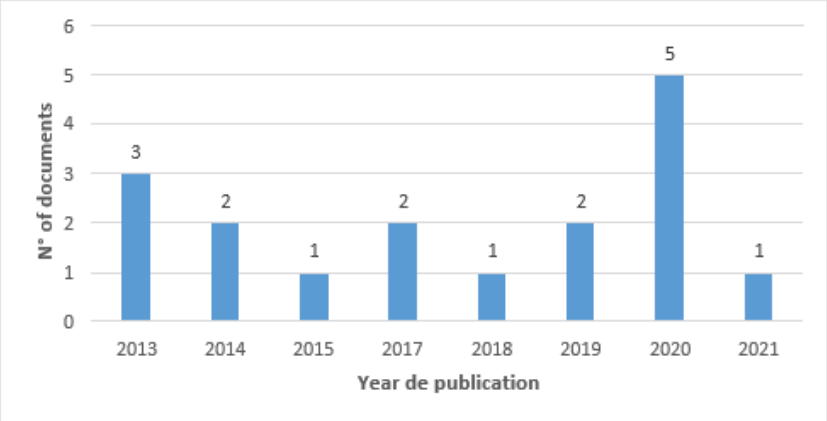

Figure 5. Documents published per year

Results on the impact of electronic medical records on health care

table 6 and figure 6 compile 19 documents that indicate the impact of the electronic medical record on patient health care. 10,53 % (2/19) explain how electronic medical records allow the attending physician to have patient information in real time and anywhere. 42,11 % (8/19) evidenced the ease that the use of this tool provides in medical care. 5,26 % (1/19) concluded that it improves cost-effectiveness in the prescribing of drug (Peters and Khan, 2014). 21,05 % (4/19) found that the use of electronic medical records provides greater safety and patient satisfaction.[27,28,29,30]

Table 6. Published documents on the impact of electronic medical records on health care

Health care	N°. documents	%
Information interoperability	2	10,53
Facilitates medical care	8	42,11
Improves cost-effectiveness	1	5,26
Patient safety	4	21,05
Patient satisfaction	4	21,05
Total	19	100,00

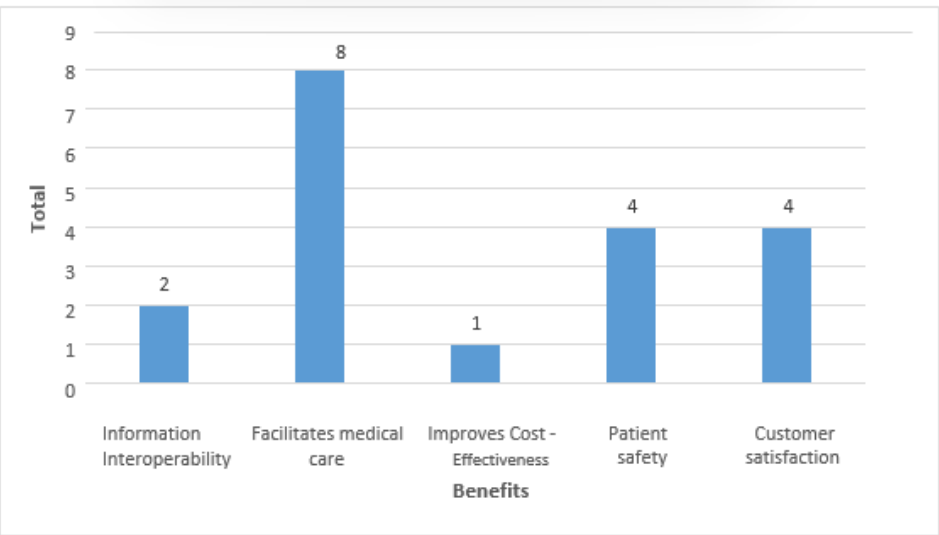

Figure 6. Published documents on clinical history and health care

Results on the impact of electronic medical records on health management

Health management is related to the quality of health services, clinical management and how all information is protected and available for decision-making in hospital management.[31]

In this sense, 11 studies were evaluated in the Scopus database as shown in Table 7 and Figure 7, in which it can be seen that 36,36 % (4/11) of the published articles show aspects of quality of care such as delay time with the treating doctor, waiting time, quality of care in the doctor-patient relationship and the efficiency of the professional who provides care.[32] On the other hand, 18,18 % of the documents dealt with the protection of the information provided by health users either during care with the doctor or digitally through the use of informed consents. Finally, 45,45 % of the reviews indicated aspects of clinical management such as the availability of information on the patient's status immediately through the electronic medical history record.[33,34,35,36] In addition to the management of food to the nutrition service in the cases of hospitalized users and the follow-up and compliance with the clinical tasks indicated by the attending physician on a day-to-day basis to the multidisciplinary health team such as students in training.[37,38,39,40,41]

Table 7. Published documents on the impact of electronic medical records on health management

Health management	N°. documents	%
Attention quality	4	36,36
Information protection	2	18,18
Clinical management	5	45,45
Total	11	100,00

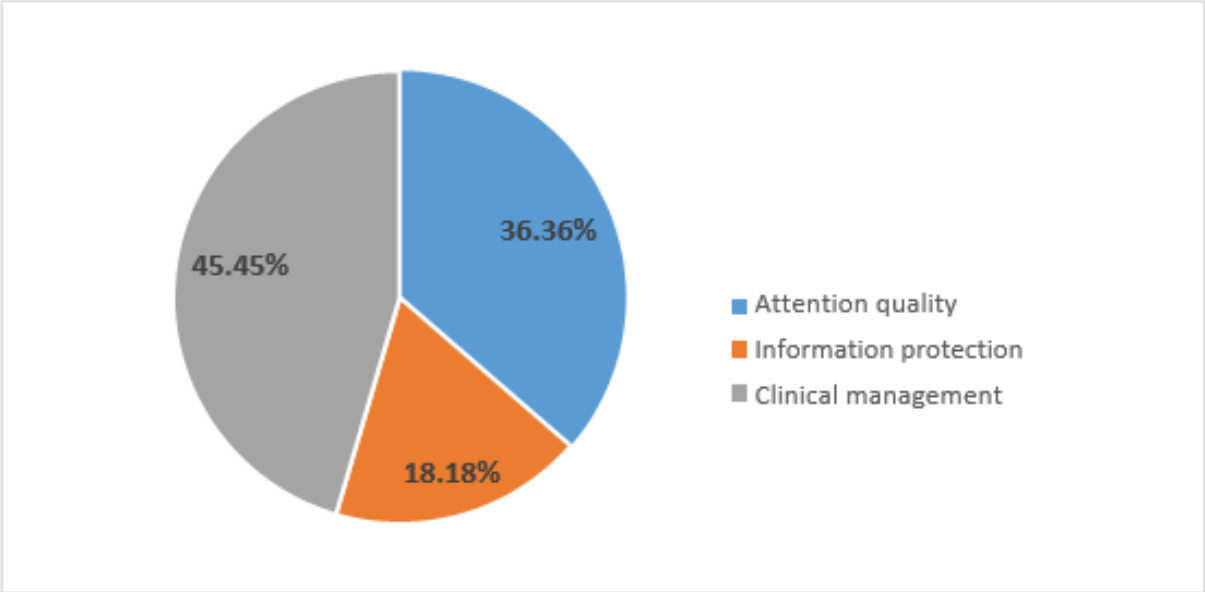

Figure 7. Published documents on clinical history and health management

Comparative results of the impact of electronic and traditional medical records

Table 8 shows 5 studies that compare patient satisfaction, clinical follow-up and the cost-effectiveness of the use of electronic and traditional medical records. On patient satisfaction, Wali et al. (2020),[42] found that with the implementation of the electronic medical record, patient care improved from 77 % to 82,3 %. Physician explanation for order generation improved from 80,7 % to 85,8 % and the medical consultation time and active listening improved from 73,8 % to 80,4 % and from 73,5 % to 77,3 %, respectively. Patients' perception of the time they have to ask the physician also improved from 79,4 % to 84 %. Finally, the physician's interest in recording in the medical record improved from 44,1 % to 57,5 %.[43]

Regarding clinical follow-up, Abiy et al. (2018)[44] found that 172 paper medical records were complete compared to 164 digital records. Also, the completeness of patient weight data is higher on paper than electronically. The completeness of pregnancy case records was significantly better on paper than digitally (74 % vs. 62 %). The average time for paper registration, as pointed out by Wong et al. (2017),[45] it was 215 seconds while in the electronic system it was 150 seconds therefore, there is a 30 % reduction in time. However, the study by Salaffi et al. (2013)[46] adds the time it takes for doctors to record their medical history, being 5.1 minutes in the computerized system, while in the traditional format it was 7,9 minutes.

Finally, Vermeulen et al. (2014)[47] pointed out that the total cost for the traditional and systematized registry is 12,37 and 14,91 euros respectively, however the incremental cost/effectiveness ratio for medication errors was 3,54, which implies that the lower the number of medication prescription errors, the lower the cost of correcting these errors.[48]

Table 8. Published documents on the comparison of the use of electronic and traditional medical records

Comparative aspects	Documents	Year
Patient satisfaction	Patient satisfaction with the implementation of electronic medical Records in the Western Region, Saudi Arabia, 2018	2020
Clinical follow-up	View of A comparison of electronic records to paper records in Antiretroviral Therapy Clinic in Ethiopia: What is affecting the Quality of the Data?	2018
	A ward-based time study of paper and electronic documentation for recording vital sign observations	2017
	Usability of an innovative and interactive electronic system for collection of patient-reported data in axial spondyloarthritis: comparison with the traditional paper-administered format	2013
Cost - Effectiveness	Cost-effectiveness of an electronic medication ordering system (CPOE/CDSS) in hospitalized patients	2014

The greater use of information technologies in developed countries compared to developing countries has increased the rate of adoption of electronic medical record systems over the last 25 years. The modernization and digitization of healthcare as a worldwide policy has prompted many countries to implement an electronic medical record system. In this sense, the EHR as a medical-legal record document stored in a digital medium, allows to record the care received by a patient, both in clinical management as well as in other aspects of health management that allows to make decisions in favor of quality care with a multidisciplinary approach.[49]

The author Chunyan (2020)[50] indicates that the use of an electronic medical record system allows patient information to be interoperable, interconnecting with all medical and non-medical services to facilitate the care received by the user. However, its main limitation is the increased risk of unauthorized access leading to disclosure of information and harming patient privacy. For their part, Peters and Khan (2014)[51] point out that interoperability increases patient safety when receiving pharmacological treatment, adding advantages such as timeliness, legibility, accuracy and availability in drug prescription, in addition to assistance and automation of clinical and administrative tasks, preventing adverse events or reactions. Although both authors explain the advantages and disadvantages of using the EHR, the author Salaffi et al. (2013)[52] mention that it is important to involve patients in the use of a computerized system that facilitates the collection of their personal and clinically relevant data. However, there are reasons such as the lack of availability of a computer and the user's own experience that limit their active participation.[53]

From a healthcare professional's perspective, Clynch and Kellett (2015)[54] state that physicians find it difficult to obtain useful information from the EHR when accessing the computer system. Even the most experienced physicians find it difficult to organize and plan each process that makes up a patient's health care, even more so if the patient has or suffers from a complex disease that leads to instability or rapid changes in clinical status. Thus, Liu et al. (2017)[55] indicates that the main factors that significantly influence the intention to use the electronic health record are: the perceived usefulness of the professional to record everything digitally, in addition to the ease of use for recording and searching for information. According to the author, attitude is another factor that greatly influences the use of the EHR as well as gender because according to his study women are more influenced by the perceptions of self-efficacy of the technology. Furthermore, according to Wong et al. (2017),[56] the registration time that doctors carry out in the EHR is significantly reduced between 30 % and 63 % compared to paper registration, therefore, it would help doctors a lot not only in their clinical practices, but also in the informed consent that the patient receives, as described by Despotou et al. (2020),[57] when comparing the recording of digital consent with the traditional form. Similarly, Wali et al. (2020)[58] found that the implementation of the EHR improves the time of medical consultation, active listening and, above all the

perception of patients to be able to ask about their health status, which made it possible to increase their degree of satisfaction. In addition, Kim et al. (2020)[59] indicates that the benefits of the reduction in the completion time of clinical tasks performed by interns with the use of the EHR are positive aspects and limitations of the impact of electronic health records on health care and management in terms of interoperability, ease of care, safety, and patient satisfaction. In the aspect of quality of care, Uslu and Stausberg (2021)[60] indicate that the EHR has a positive influence on the quality and efficiency of care, as well as on cost reduction. Similarly, Wali et al. (2020)[61] state that improving the doctor-patient relationship using the electronic health record improves the quality of services and the user saves time for other activities. Finally, for Tran et al. (2020),[26] the implementation of a medical record application is feasible, acceptable and viable for the collection of user data, as it is a reliable tool and, above all, easier to use than traditional paper, maintaining the confidentiality of the patient's data, even more so, giving them confidence in their treatment plan and Maia Chade et al. (2019),[35] and Kim et al. (2020)[36] indicate that the work efficiency of medical interns and improving the workflow within clinical management. There is no doubt that the impact of the use of the EHR is beneficial for all the actors involved in the care and health management process.

CONCLUSION

42,11 % of the studies indicated that the EHR facilitates medical care, while only 21,05 % and 18,18 % indicated that the use of the electronic medical record offers greater security and protection of information respectively compared to the traditional paper registry. Regarding patient satisfaction, this increased from 77 % to 82,3 % and the doctor's interest in registering in this digital medium increased from 44,1 % to 57,5 %. In general, the quality of care as the main indicator of health management was evident in 36,36 % of the total articles reviewed.

Studies show that the use of electronic medical records is transcendental in the field of health sciences because it allows information to be exchanged quickly, accessed immediately from wherever one is, and thus speed up and coordinate responses in detail. that the healthcare professional provides in the follow-up, monitoring and continuous treatment of the patient. The multidisciplinary management provided to the user improves their perception of the care they receive and the relationship with their treating physician so that the service provided is of quality due to the coordination of clinical management. These aspects serve precisely as indicators to measure the management of health establishments.

Access to data must be available according to the profile or work carried out by the professional to safeguard privacy and protect user information. Like all software, the EHR must have backups and backup copies, in addition to restricting access so that authorized personnel can view, record, edit or delete some type of information. However, there are still limitations on the information security of electronic medical record systems, such as the complexity that sometimes arises in the development of an electronic medical record application due to an endless number of processes that require certain types of patients and, above all, all unification in a single system that shows parameters or indicators of good health care and reports that demonstrate the management of health management in real time. Therefore, the participation of all those involved in the health care process is recommended for the development and implementation of the EHR.

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