ROLE OF ELECTRONIC HEALTH RECORDS FOR CHRONIC DISEASE MANAGEMENT- A SYSTEMATIC REVIEW

Dissertation Submitted to

The IIHMR University, Jaipur

for the partial fulfillment for the award of the degree of

Master of Business Administration (MBA)

in

Hospital and Health Management

by

Sohini Chakraborty

Under the Supervision and Guidance of

Dr. Monika Chaudhary

2022

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DECLARATION BY STUDENT

I hereby declare that this dissertation titled "**Role of Electronic Health Records for Chronic Disease Management- A Systematic review**" is the bonafide record of my original research work. I declare that it has not been submitted to any other university or institution for the award of any degree or diploma. Information derived from the published or unpublished work of others has been duly acknowledged in the text.

Sohini Chakraborty

(Signature)

Name: Sohini Chakraborty

Date
30/06/2022

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Date: 30th June 2022

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During this period of internship, her performance was good.

We wish her every success for the future.

Regards,
For **ExpressRCM Private Limited**

Authorized Signatory

CERTIFICATE

This is to certify that dissertation titled "**Role of electronic health records for chronic disease management- a systematic review**" is a record of the research work undertaken by Sohini Chakraborty in partial fulfillment of the requirements for the award of the degree of MBA (Health Management from the IIHMR University, Jaipur under my guidance and supervision and his/her approach to the research study has been sincere, scientific, and analytical.

Faculty Guide IIHMR University, Jaipur	School Dean IIHMR University, Jaipur
Date	Date

Abstract

Public health and health systems around the world are significantly challenged by Chronic Diseases which are now the primary causes of disease burden, limiting social and economic development. For patients and healthcare professionals alike, chronic illnesses present significant challenges. The EHR software technology's clinical decision support capabilities enhance overall chronic illness management. In this research article, we tried to determine the roles and effects of EHR for the target group, which consists of people with two or more chronic illnesses. By systematic literature review, we tried to address the limitations of the EHR functionalities and put the emphasis of the electronic health record which must change from the patient's medical record to intelligent plan-centric health plan, from the support of clinical transactions to the delivery of information to both provider and the patient, allowing the providers to adopt a new value-based care business model for healthcare.

Keywords: Chronic disease management, Electronic Health Records, Interoperability, Health Information Technology

Acknowledgments

First, I am greatly thankful to my mentor and professor, Dr. Monika Chaudhary, who has been my constant guide to carry out my project and giving necessary decision. Secondly, I extend my gratitude to the Placement Committee of IIHMR University for successfully arranging this internship. The internship opportunity I had with 314e Corporation Private Limited was a great opportunity for learning and professional development. Therefore, I am lucky as I was provided with an opportunity to be a part of it. I am also grateful for getting such an exposure to meet so many wonderful people and professionals who led me though this internship period.

I express my deepest gratitude to Mr. Gaurav Mundra, VP (Production and Marketing), 314e Corporation Pvt. Ltd., who despite being extraordinarily busy with his duties, took time out to hear, guide and keep me on the correct path, constantly guiding and allowing me to carry out my project at their esteemed organization. I would also like to acknowledge the contribution by Supriya Sen, Product Manager at Avoraus Consultancy Services Pvt. Ltd. for giving necessary advice and guidance and arranged all facilities to make this training easier.

I like to place my best regards and deepest sense of gratitude towards Dr Rashika Sharma, Product Manager, and my fellow intern colleagues for their careful and precious guidance which were extremely valuable for my study both theoretically and practically.

I will always strive to use gained skills and knowledge in the best possible way and perceive this opportunity as a big milestone in my career development. I will continue to work for improvement, to attain desired career objectives.

Sincerely,
Sohini Chakraborty
Place: IIHMR University, Jaipur
Dated: 30/06/2022

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Abbreviations

EHR	Electronic Health Record
WHO	World Health Organization
CAGR	Compound annual growth rate
NLM	National Library of Medicine
IT	Information Technology
APIs	Application Programming Interface
HIT	Health Information Technology
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PROMs	Patient-reported outcome measures
RCT	Randomized controlled trial
IOM	Institute of Medicine
ONC	Office of the National Coordinator for Health Information Technology
HITECH	Health Information Technology for Economic and Clinical Health
SDO	Standards Developing Organizations
HIMSS	Healthcare Information and Management Systems Society
HL7	Health Level Seven
HIE	Health Information Exchanges
CPRI	Computer-based Patient Record Institute
CKD	Chronic Kidney Diseases
CDS	Clinical Decision Support

Chapter 1: Introduction

1.1 EHR and its role in chronic care and treatment

Public health and health systems around the world are significantly challenged by Chronic Diseases which are now the primary causes of disease burden, limiting social and economic development **(1,2)**. Despite the fact that people are living longer and adopting healthier lifestyles than ever before, people over 60 account for over 23 percent of all deaths and illnesses worldwide. A large portion of this burden is attributed to chronic diseases like diabetes, cancer, chronic respiratory illnesses, heart diseases, and neurological disorders. By 2030, the World Health Organization (WHO) predicts that there will be 52 million cases of chronic disease-related deaths **(3,4)**.

For patients and healthcare professionals alike, chronic illnesses present significant challenges. The EHR software solution offers a great option for doctors to manage patients with chronic ailments over time and chronic diseases need to be monitored often. The term "electronic collection of health-related data relating to one topic of treatment, i.e. the patient" refers to electronic health records (EHR) **(5)**. Healthcare organizations or hospitals compile structured collections of pertinent patient data, which are then saved digitally and made instantly and securely available to authorized users. Even patients with a variety of chronic diseases can benefit from greater care coordination between medical staff and patients. The EMR software technology's clinical decision support capabilities enhance overall chronic illness management.

The rate of EHR adoption is rising globally at a 9.3% CAGR, and the market for EHRs will be worth USD 52.98 billion by 2027 **(6).** As the use of EHRs is now almost generally embraced, it is extremely appropriate to assess how the EHR supports chronic illness management and diagnosis, as well as the problems that develop when using these tools that lower diagnostic safety and increase diagnostic error **Figure 1.1** gives a thorough explanation of the connections between the healthcare organization, health-related information supplied by the medical professionals who provide the EHR, and other functionalities that might be made available to or can be used by patients.

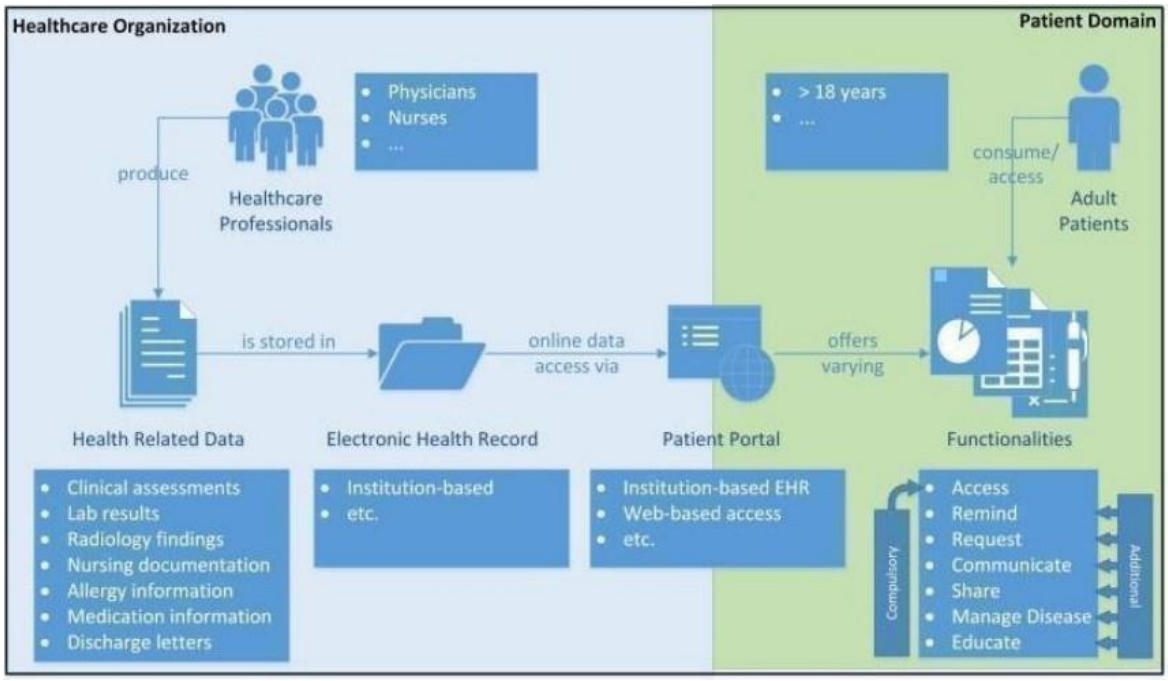


Figure 1.1: How EHR works in patient care and coordination **(7)**

1.2 EHR Interoperability

Healthcare professionals were strongly urged to adopt electronic health records (EHR) rather than paper-based data when the HITECH Act was introduced in 2009. Interoperability with an EHR refers to how simple it is to exchange medical records and healthcare data from one provider or system to another. The ONC states that for an EHR to be fully interoperable, four critical technological domains must be properly linked. These consist of:

- User interaction with an application
- system interactions
- processing and administration of information
- Device integration for consumers

Alternatively, the EHR must effectively communicate with other parties, like as doctors, pharmacists, and patients who are at home. This makes it possible for the appropriate persons to swiftly obtain health information while keeping others who do not require it out.

1.2.1 Importance of Interoperability

EHRs Must Be Able to Share Information

Any healthcare institution that uses an EHR system will benefit most from its capacity to share data with other parties who require access. This benefit is completely lost if the system is not compatible. EHRs were initially intended to help patients receive higher-quality treatment, to help doctors coordinate care, and ultimately to reduce the cost of providing healthcare to both individuals and companies.

Of course, not all EHRs will be suitable for all healthcare systems. Although there are now only a few major players, health care organizations often select the EHR providers that best suit their requirements based on patient populations, usability, and financial limitations. Because of this, information sharing between EHR systems requires that they be interoperable.

Communication

A major advantage of enhanced interoperability is improved communication since the optimal outcomes require that various systems be able to communicate with one another. Systems won't be able to decipher information provided from one system to another to produce useful patient data if they are not interoperable **(Figure 1.2)**.

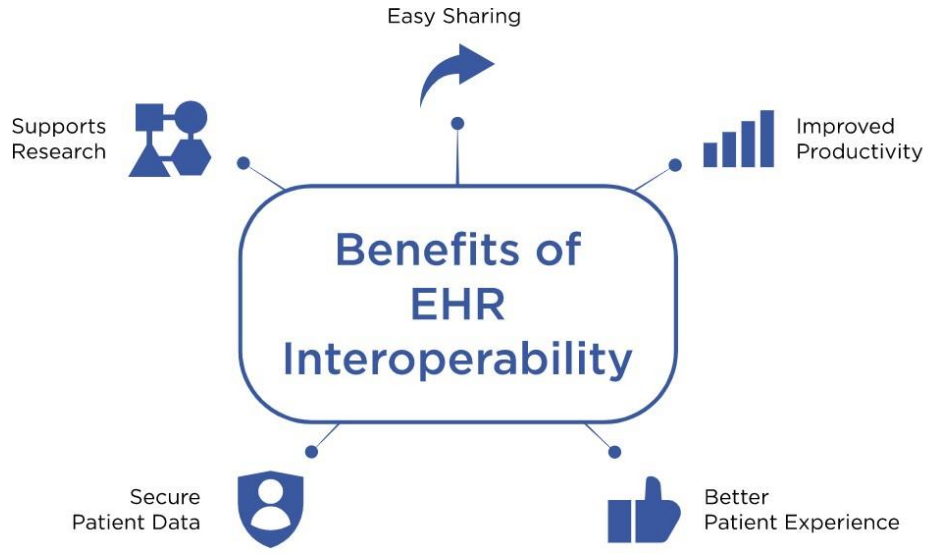


Figure 1.2 Benefits of EHR Interoperability (8)

But despite these requirements, many vendors continue to favor obscurity. When this occurs, healthcare personnel are forced to send patient data through antiquated communication channels like faxing and even handwritten documentation. To access a complete database of data for many of their patients at most hospitals, a practitioner will need to use more than a dozen EHR systems. This inadequate communication would never occur if EHR systems were fully interoperable. Instead, essential health information would be readily available to both patients and healthcare professionals, improving overall health outcomes.

1.2.2 Barriers to Interoperability

However, the expansion of EHR options does not suggest that the degree of interoperability envisioned at the start of this transition to digital clinical information systems has been achieved by American healthcare providers. To reach the highest level of interoperability, multiple technology and EHR companies, governmental bodies, and healthcare systems must address the capacity of different types of EHR systems to communicate and function smoothly across all the key connections in healthcare infrastructure. The ONC, federal government, and SDOs have all played important roles in defining data exchange standards in healthcare. EHR companies have

also played a significant role in supporting interoperability. While EHR companies developed the technology of their platforms to improve the capacity to interface with other software and apps, SDOs focused on developing standards for clinical language, standard terminologies, patient identification, information interchange outlines, privacy, and security. All EHR system has a unique user interface and the capacity to carry out a wide range of tasks. It is extremely difficult to convey this information since systems talk in various coding languages and have diverse vocabularies. Aside from these issues, enhancing interoperability may also be monetarily challenging **(Figure 1.3)**

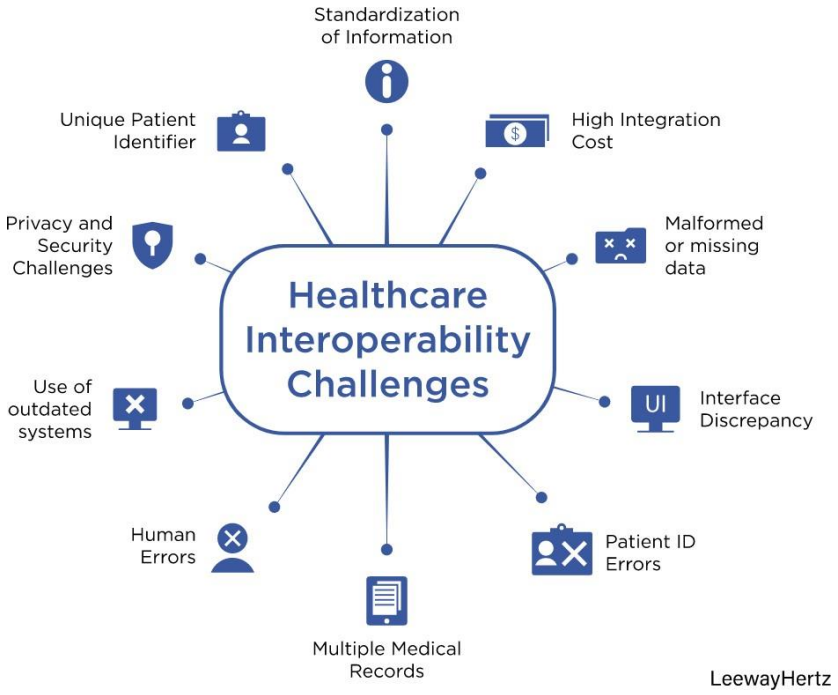


Figure 1.3 Challenges of EHR Interoperability (8)

Currently, exchanging crucial patient health information across healthcare systems is more challenging because there are several HIEs and EHR providers, and they all use various codes, languages, and formats. For this reason, SDOs have prioritized standardization to create a more streamlined process.

1.2.3 In direction towards deeper Interoperability

It will be necessary to dismantle EHR and healthcare IT development barriers in order to assist healthcare providers in achieving deep interoperability. Technology advancements, standardized APIs for data transmission, ease of technology use, and ongoing evaluation of the effects of HIT on patient outcomes and care coordination can all help achieve this.

Today, a wide range of stakeholders, including payers, providers, EHR suppliers, and other HIT firms, are participating in defining interoperability. The coordination of various parties to produce consensus-driven advancements in HIE and technology continues to be a major topic of study. While there are still challenges to overcome before we can really transition to a value-based healthcare system, EHR suppliers will be essential in assisting providers in attaining deep interoperability and upgrading HIE.

1.3 Purpose of Research

Health IT design looks for the ability to sort through voluminous data and identify the details that are relevant to the patient's circumstances. Providers and administrative staff still struggle with determining which issues should be recorded, which information should be documented, and what the best course of action should be for each patient in terms of both treatment and prevention. Providers continue to experience problems with user interfaces, usability, the quantity and quality of submitted data, and gaps in data interoperability between systems while implementing electronic health records.

To address these problems, the emphasis of the electronic health record must change from the patient's medical record to their health plan, from the support of clinical transactions to the delivery of information for both the patient and the provider, allowing the providers to adopt a new value-based care business model for healthcare.

1.4 Objective of the Study

The main goal of this study is to identify the functions and effects of EHR for the target group, which consists of people with two or more chronic illnesses whose estimated duration is one year or more, or until death. Through more carefully constructed plan centric EHR implementation, we also attempted to analyze potential future trends and prospects for clinical outcome improvements in this study.

1.5 Research question

This comprehensive literature review's primary goal was to answer the following questions:

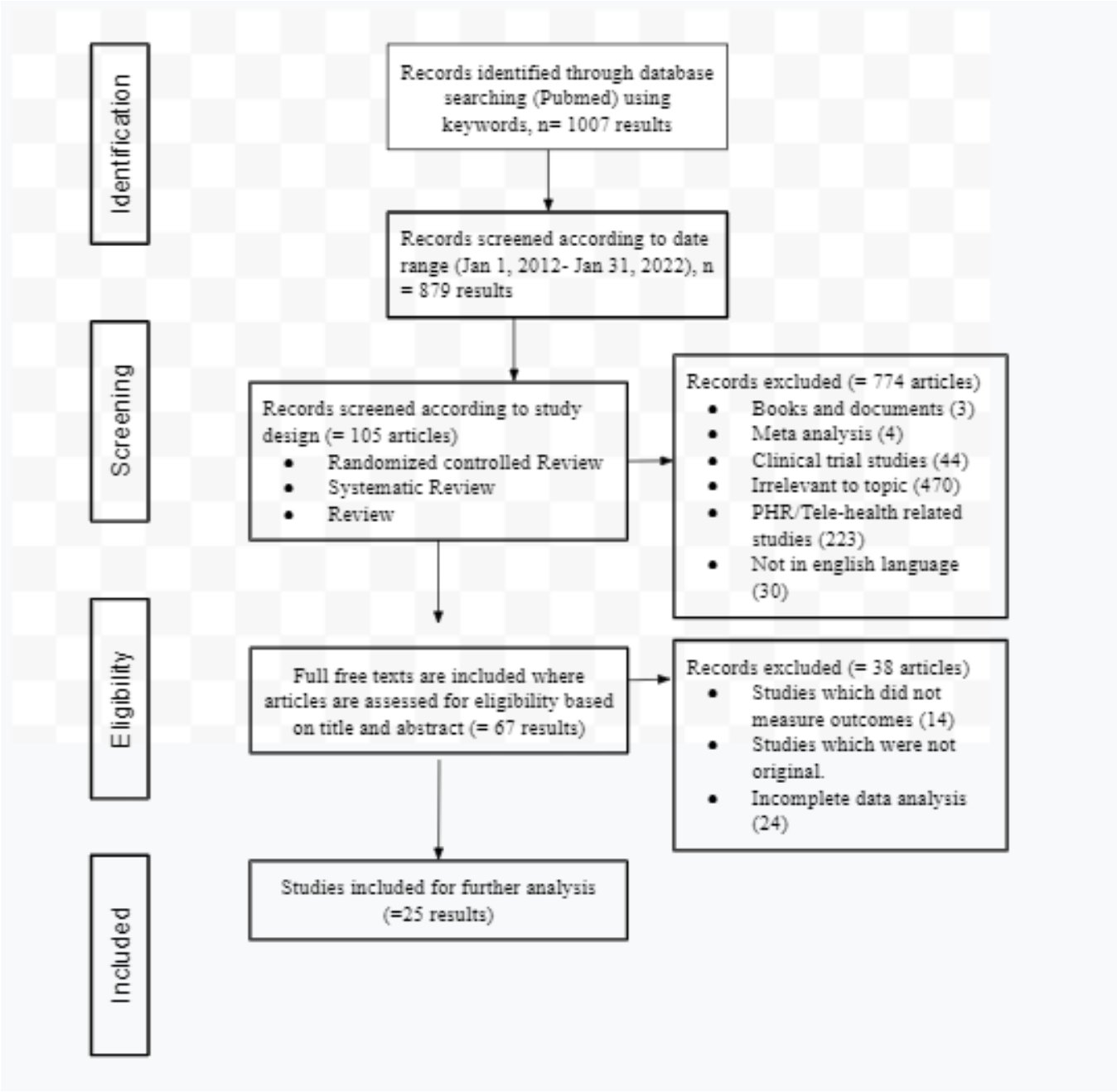
- How effective is Electronic Health Record (EHR) for examination of patient health outcomes suffering from chronic diseases?
- What are the chances for more advancement across a range of outcome measurements to create improved clinical procedures, features, and workflow processes of EHR systems?

Chapter 2: Methodology

A systematic literature review was undertaken on studies to explore the effectiveness of electronic health records for patients with chronic diseases. Full-text articles published in English language were manually searched from PubMed (National Library of Medicine [NLM]) databases following PRISMA guidelines.

After the identification of total 1007 publications, the exhaustive three-stage selection of the related articles was carried out. At first, the articles were screened according to materials issued between Jan 1, 2012- Jan 31, 2022. At the second step, using the criteria for the type of study, the remaining publications were assessed. We used randomly selected or controlled trial designs or a systematic review of research that examined EHR functionality, patient care improvement, and EHR constraints with reference to the management of chronic diseases. We also employed research articles to increase the capture of academic articles based on the study objectives. Finally, 25 articles are included, those who continued to meet the inclusion criteria were chosen for data extraction. The information that was retrieved includes general information (author name, publication year, study purpose), technique (study period, study design, study setting) and key findings (EHR functionalities, benefits/limitations of EHR use). To create this review study, the data derived from the cited materials was further evaluated and future directions were adjusted. The complete study review process is shown in this flowchart **Figure 2.1**.

Figure 2.1 Flow diagram of article identification, screening and selection using PRISMA Guidelines



2.1 Keywords

("chronic disease" OR "disease management") AND ("electronic health records" OR "Web-based Communication") NOT PHR NOT telemedicine NOT telehealth

2.2 Inclusion and exclusion criteria

• Inclusion criteria:

I. Articles in the English language

II. Studies between the date range: Jan 1, 2012-Jan 31, 2022.

III. For the purpose of documenting EHR outcomes, improved care of the patients with chronic diseases, and identifying their limitations, this research searches for randomized-controlled studies, review articles, and systematic literature reviews.

• Exclusion criteria:

I. Studies that didn't record results.

II. Studies that lacked originality or shown insufficient data analysis

III. Research that was not written in English was rejected.

IV. Studies relating to PHR/Telehealth were disregarded.

V. Excluded publications, books, and meta-analyses related to clinical trial research.

2.3 Ethical Considerations of this review

- Data should not be revealed before releasing to the researcher.
- Assumption is made beforehand that consent of study subjects were made before adaption in this systematic review.
- All sources will be properly cited and will be personally reviewed. The associated findings will be real, and the original data can be provided, on request, for inspection and validation of findings.

Chapter 3: Review of the literature

3.1 Evolving Landscape of EHR

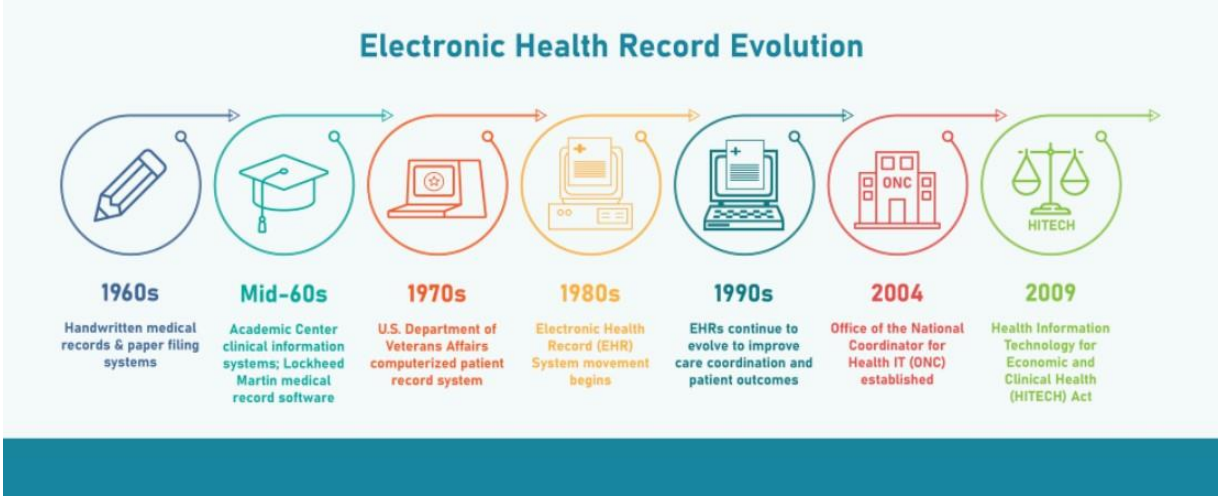


Figure 3.1 Evolution of Electronic Health Records (EHRs) (9)

- Doctors and other healthcare professionals kept patient medical histories in handwritten format of paper-based medical records and a paper directories until the middle of the 1960s when education centers started to create their own clinical IT systems to store electronic medical data.
- Companies and healthcare organizations collaborated to create technologies for storing and accessing electronic medical data throughout the following ten years. A computerized patient record system was put in place in 1970s, which contributed to lowering medical errors and raising standards of treatment.
- A campaign to stop using paper-based medical records and create a digital system in the US gained traction throughout the 1980s and 1990s. When using paper filing systems, patients were unable to take their medical records with them, have quick access to them in an emergency, or use them when they changed healthcare systems and doctors.

- The IOM financed education and produced publications beginning in 1991 that paved the way for the principles underlying modern electronic health record systems **(10).**
- Since "health" is defined as "a condition of well-being" and the purpose of digitalizing medical data stands to enhance the delivery of safe, high-quality treatment that is centered on patients' health, the IOM chose the designation electronic health records in 2003.
- HIPAA Security Rule mentioned that all types of personally identifiable health information kept in electronic format is now protected by the Security Rule. A number of the administrative processes mentioned in the IOM report have their transaction formats standardized by HIPAA as well.
- The ONC as formed by President George W. Bush in 2004 to oversee the development of an interoperable health information technology infrastructure. In order to achieve universal adoption of EHR within 10 years, ONC released a framework for strategic action with 4 goals and 12 methods **(11).**
- An update to the strategic framework, was issued in June 2008 by the ONC. (*Federal Health IT Strategic Plan (ONC): 2008–2012 (Washington, DC: U.S. Department of Health and Human Services, Office of National Coordinator, June 3, 2008, pp. iii–iv*). Healthcare that is patient-centered and population health were the two goals of the strategy, and each aim had four targets. While common to all of the goals, the themes of privacy and security, interoperability, IT adoption, and collaborative governance relate to healthcare and population health in very diverse ways.

- After that, in 2009, Barack Obama introduced the Health Information Technology for Economic and Clinical Health Act **(12)**. The HITECH Act demonstrated how strongly it supported the utilization of EHRs. By allowing the CMS to reward physicians and medical facilities for using certified EHRs, the act promoted wider adoption of EHR. The objective of having a secure EHR for every American was to be attained, hence these incentives were designed to encourage the use of EHR.
- CMS released The EHR Incentive Program Final Rule, which was formally released by CMS on July 28, 2010, specified the standards for establishing "meaningful use" and concluded the incentive programme **(13)**.

3.2 Systematic literature review of the included studies

Authors and publications on EHR applications and understanding their key outcomes are summarized below in **Table 3.1**

Author, Year	Purpose of the Study	Study Design	Setting	Period of Study	Key Findings
Persell, S. D., et. al (2018) **(14)**	To compare the effectiveness of medication management tools delivered via a commercial electronic health record (EHR) with and without a nurse-led education intervention.	Randomized clinical trial	Community health centers- Chicago, Illinois	April 30, 2012 - February 29, 2016.	• EHR tools improved medication and care coordination but no improvements were found in controlling blood pressure. • With nurse-led intervention support, outcomes

					of understanding medication instructions and dosing were improved but no effects were found in managing hypertension
Coorey, G., et al. (2021) **(15)**	The purpose of this study is to assess the fidelity with which an eHealth intervention is delivered, to describe usage patterns and outcomes and to identify facilitating factors on intervention delivered and received.	Mixed method Study	Conducted in primary health care services in Sydney, Australia.	2020	• A multi-feature internet-based intervention which involved medication and cardiovascular risk data (retrieved from EHR) was utilized by sample users with high fidelity to the RCT protocol. • Higher utilization by users was not associated with eHealth literacy rates, lifestyle changes, or clinical outcomes as an indicator of greater intervention exposure. • The intervention's characteristics and customized support influenced both initial and ongoing use.
Richter, J. G. et al (2016) **(16)**	The adoption of electronic health	Article	Germany	2016	• Structured, standardized ,

	records in everyday patient care is one of the potential described in the article. The scenarios for secondary use are described. It also emphasizes patients' perspectives on electronic data gathering systems and their usage in everyday treatment, as well as active participation of patients in management of diseases using apps based on health information. In context of EHRs and associated processing of data, pertinent legal and regulatory issues are addressed.				longitudinally built recording opportunities, as well as automated grading methods, have made long-term systematic patient-centered data collecting possible. ● Mobile device integration with EHRs and current patient documentation systems may result in more frequent, remote, and ongoing documentation of important outcome metrics enabling the development of new, improved individual management approaches.
Rao, S. et al (2012) **(17)**	This article talks about how chronic disease is managed in primary care. In addition to the role that HIT plays in simplifying complex chronic disease,	Article	United States	2001-2011	● EHRs and HIT enhance patient self-management, safety, and satisfaction while lowering costs and improving health outcomes. ● EHRs and health

	how HIT can bring a change in health care transitions, and the upcoming directions of HIT and chronic disease management are all described. Recent efforts by federals to increase the adoption of EHRs are also discussed.				IT can be tailored to each provider's and patient's preferences, enabling collaborative interaction between them. HIT will alter primary care as more people live with chronic diseases as it becomes increasingly vital.
Lessing, S. E. et al (2019) **(18)**	Researchers can revisit the effects of specific EHR features on a range of outcome measurements by comprehending the related methodological issues and acknowledged limitations by authors in few studies. This will allow them to create improved clinical procedures, advancements related to technology, and features for EHR software systems and workflow procedures	Systematic literature review	United States	March 2003 and November 2017	• Logistic regression analysis was used. • Measured outcomes included HbA1C, blood pressure, and LDL cholesterol levels. • Determining how EHR systems can be used for novel medicine and treatment alternatives in addition to improving the quality, cost-effectiveness, and continuity of care is a promising topic for research targeted to improve patient outcomes in the

					management of diabetes and chronic diseases.
Walsh, A., et al (2018) **(19)**	This review considers the strengths and weaknesses of 7 patient-provider communication platforms	Article	Denmark, United States, the Netherlands, and the United Kingdom	2012-2017	• eHealth Systems have the capacity to gather a lot of information. • Information like Demographic data, patient-reported outcomes (symptoms, quality of life), care-quality indicators (steroid use, among others), and outcomes like hospitalization are all included in the data. • These facts might help quality improvement initiatives narrow their focus.
Shen, Y., et al. (2020) **(20)**	This review aims to present a comprehensive view of how electronic health records can be translated into scientific discoveries, for instance, among patients with diabetes and their key methods for	Article	US, Europe, China	-	• Linking changes or variability of risk variables with outcomes will be of significant interest as a future direction given to the vast longitudinal data in electronic health records. • National registries

	analysing the relationships between risk variables and outcomes.				in China will assist medical professionals with routine management, particularly for chronic diseases like diabetes. ● The incredibly abundant population resources will undoubtedly offer significant and substantial evidence on therapeutic practice.
Ammenwerth, E. et al (2021) **(6)**	No matter what the patient is suffering from considering the type of healthcare organization from where they receive treatment, adult patients can use an institutional-based electronic health record (EHR) and its consequences will be examined in this research.	Systematic literature review	United States	June 2017-April 2020	● This article showcases the protocol for Cochrane review. ● The effects of offering adult patients access to electronic health records (EHRs) on a variety of patient, patient-provider, and resource consumption outcomes, such as patient knowledge and understanding, patient empowerment, patient adherence, patient satisfaction

					with care, adverse events, health-related quality of life, health-related outcomes, psychosocial health outcomes, resource consumption are determined ● Also, whether giving adult patients access to their EHR alone or giving them access with extra features has different results according to the patient groups' age, educational attainment, or disease status (chronic or acute) are also considered.
Larson, E. A et al (2015) **(21)**	The expansion of clinical informatics and the incorporation of translational genomics are 2 drivers that are explored in the study, and also various cases where these forces are assisting patients in	Article	United States	2014	● Genomic risk scores are being combined with structured family histories (disease-specific pedigrees) entered by the patient to reclassify disease risk and target people at risk in the direction of

	avoiding possibly avoidable events are also highlighted.				prevention and automatic decision-making. ● High-priority gene variations are progressively being deployed. ● This method is used to maximize treatment response and enable early diagnosis.
Pouladi, N., et al (2016) **(22)**	To identify illness underlying the biology and etiology of disease comorbidity, in this article, the author discussed research prospects of the past, present, and future using phenotypic and molecular information.	Literature review	United States	2006-2015	● This review focused on the evolving approaches to comorbidity elucidation that make use of multiscale molecular data and patterns from electronic health records.
Lewy, H.,et al (2019) **(23)**	The development of PHS in the Israeli healthcare system over the past ten years are illustrated in this article, together with the initiatives and infrastructures planned for R&D on PHS in the system's future. We go over	Article	Israel	2018	● The care provider is better equipped to recognize and treat patients with chronic diseases and offer individualized prevention utilizing electronic health records (EHRs) that incorporate predictive models for the likelihood

	the lessons discovered and provided fresh ideas for PHS research, related development with implementation, and assessment that would consider the requirements of future HC.				of illness start and deterioration. ● Comorbid patients who participated in integrated telecare programs showed improved clinical results, self-management, and quality of life. ● A framework for collaboration between healthcare, academia, and industry for the development and implementation of future PHS is created by this strategy in conjunction with national programs and incentive payments.
Kruse, C. S., et al (2015) **(24)**	The goals of this systematic review are to pinpoint the portals' common traits that patients and providers find appealing as well as to pinpoint the components that they feel should use improvement.	Systematic literature Review	United States	January 2004 and July 2014	● According to this systematic research, patients and their doctors have differing opinions on using patient portals to manage their chronic illnesses. ● According to the authors, the adoption of patient portals in healthcare organizations will

					be aided by a standard patient portal design that gives patients the tools they need to comprehend and manage their chronic diseases.
Lund, L. H. et al (2017) **(25)**	Heart failure (HF) randomized controlled trials (RCTs) are become more difficult and expensive to carry out, and if successful, they only evaluate pricey therapies on a limited number of people.	Article	Swedish Heart Failure Registry	2016	• Practical and paper-based prospective RCTs are made possible by electronic health records and clinical cardiovascular quality registries (RRCTs). • Regulation, ethics, and consent processes can be made simpler, recruitment can be mixed into real-world care, baseline and outcome data can be collected more quickly and efficiently, generalizable results can be delivered at a lower cost, and there may be room for novel, evidence-based uses of generic

					drugs that are less expensive for society.
Robbins, T., et al (2018) **(26)**	This work first reviews the direct use of EHRs as a diabetes research tool. It takes into account the applications, constraints, and upcoming tactics. Identifying the gaps in the study literature and how to approach and get beyond obstacles to EHR research, also offers a significant benefit.	Systematic literature review	17 different countries	2006-2018	• The use of EHRs as a data source for diabetes research is well supported by a growing body of research. • Large data sets are frequently included in published studies, although they are frequently constrained by issues with generalizability and missing values (many of which are necessary for research on diabetes). • The few journal articles that have been published, utilizing UK data indicates that this type of research is still in its infancy in the UK. • However, the UK offers an intriguing and nearly unique context for this kind of study, with national unique

					patient identities enabling large multi-center sample sizes to overcome generalizability difficulties and maximize the clinical value of results.
Carroll, J. C. et al (2017) **(27)**	To determine the percentage of patients in primary care who report having a family history of type 2 diabetes, coronary artery disease, breast cancer, or colorectal cancer (CRC); Asses whether adequate screening was guided by risk based simply on FH; compare concordance of FH information collected from the electronic medical record (EMR) to patient-completed health questionnaire	Randomized controlled trial	Ontario and Alberta, US	2016	• For 4 illnesses, a moderate prevalence of FH was discovered, and screening advice varies according to risk based on FH. • It was deemed viable to have patients self-complete an FH, however there are still concerns about the accuracy and completeness of the FH from both the self-report and the EMR. • The best way to encourage the use of FH tools in practise and develop methods for connecting family risk to the right screening are still to be determined.

Toerien M. (2013) **(28)**	The hazards to interactions between medical personnel and patients were highlighted by the author as one set of risks related to the usage of EPR. The author of this review summarizes the data supporting some of the most important interactional dangers associated with the use of EPR, which were obtained from studies that paid close attention to the recordings of actual consultations. I then go over the research supporting different approaches to incorporating EPRs (Electronic Patient Records) into practice that can not only minimize these hazards but also improve therapeutic communication. I contend that these results strongly support the need for teaching EPR users being sensitive to the effects of EPR use on interactions, as well as for the	Article	Epilepsy Programme at Beaumont Hospital	2013	• Because there is currently a substantial body of data demonstrating the correlations between effective communication and improved patient outcomes and satisfaction, the author has concentrated on interactional dangers of EPR usage in this article.

	design of EPRs.				
Suresh S. (2016) **(29)**	This study examines the utilization of a pediatric risk score system, which gives an early indication of clinical decline and is linked to the hospital's electronic medical record. Dashboards are an essential tool for peer benchmarking in illness management systems and can help to cut down on unneeded variances in care.	Article	The Children's Hospital Association (CHA) Pediatric Health Information System (PHIS), US	2016	• Big data and predictive analytics work together to create treatments that are tailored to each child's needs. This allows doctors to prescribe medications that are right for each patient, rather than merely giving them out because they are generally effective. • As people become more savvy consumers who collaborate with their doctors to get better results, the role of the patient will alter. • Because of alarms from their genome analysis, the predictive models that doctors communicate to them, the growing usage of apps and wearables, and improved accuracy in the information required for good predictions, patients may

					become more aware of potential personal health hazards. They will be motivated to improve their lifestyles as a result of this insight, which will benefit their long-term well-being.
Kooij, L. (2017) **(30)**	To conduct a thorough evaluation of the literature on the effectiveness of outcomes related to provider or professional, procedure, clinical, health, and financial outcomes of shared care treatments in chronic disease. Additionally, we wanted to list the qualities of the IT applications that facilitate these interventions.	Systematic literature review	US	2006 to 2015	• IT-supported shared care can enhance immediate results, including PCPs' confidence and satisfaction, particularly when employing electronic communication tools. • Mixed reports of favorable impacts on proximal and distal outcomes were also made. • Surprisingly, there weren't many research that supported these predicted advantages. • Studies revealed significant variety in the populations covered, the outcomes

					measured, and the IT applications employed. As a result, no strong conclusions can be reached. ● Evidence is required to determine the precise added value of IT in shared care interventions due to the rapid development and implementation of IT applications. needed for this.
El Miedany, Y. et al (2016) **(31)**	To evaluate the use of electronic patient-reported outcome measures (ePROM) in routine clinical practise for the treatment of early rheumatoid arthritis (RA), the value of ePROM in enhancing clinical care, and how technological aspects can help patients adhere to their treatment regimens.	Randomized controlled trial	United States	2015	● The purpose of this study was to evaluate how well ePROM was being used by RA patients. ● According to the findings, ePROM can be administered via tablets, PCs, and smartphones. ● The patient's disease activity measurements could be included, and based on the results, clinically appropriate actions could be done that were suited to the

					patient's situation and would reflect on the illness control and aim attained. ● According to the study, ePROM is equal to traditional paper PROM format. ● Additionally, it made it possible for patients to keep track of their own progress with relation to disease activity, which improved their adherence to therapy.
Xie, F. et al (2022) **(32)**	Temporal electronic health records (EHRs) hold a variety of data for ancillary purposes including managing chronic diseases and predicting clinical occurrences. The depiction of temporal data still faces difficulties. Therefore, we set out to systematically examine deep learning solutions in order to uncover these issues and assess novel techniques for	Systematic literature review	United States	January 1, 2010, to August 30, 2020.	● For clinical prediction modelling and data usage, temporal EHR data provide a number of significant obstacles, including data irregularity, heterogeneity, sparsity, and model opacity. ● Current deep learning techniques can address these issues to some extent.

	resolving them.				• Future research may take into account creating full, integrated solutions. • To aid clinical application, researchers should also improve model interpretability and incorporate clinical domain expertise into study designs.
Vollmer, W. M. et al (2014) **(33)**	Analyze the effectiveness of two automated phone reminder strategies linked to electronic medical records (EMR) for enhancing prescription compliance for cardiovascular disease.	Randomized clinical trial	3 large health maintenance organizations of US	December 2011 - November 2012.	• Measuring cardiovascular disease risk factors and adherence to prescribed chronic illness drugs can both be made better with the help of technology-based techniques and an EMR.
Bardach, N. S. et al (2013) **(34)**	In the context of an established quality improvement project, determine the impact of a P4P incentive on quality in small practices with EHR integration.	Randomized controlled trial	Small (less than 10 clinicians) primary care practices in the City of New York	April 2009-March 2010	• According to the study, a P4P program in small practices access to an EHR resulted in moderate improvements in cardio-vascular processes and outcomes. • This shows that

					small practises could be able to raise their quality performance in response to an incentive when the adoption of EHRs with powerful clinical management capabilities is increasing.
Francisco, M. et al (2016) **(35)**	In order to assist US rheumatologists in meeting the substantial challenges of a fast evolving healthcare system, the American College of Rheumatology (ACR) developed the Rheumatology Informatics System for Effectiveness (RISE) Registry.	Article	American College of Rheumatology	August 11, 2016	• The benefits of RISE include convenience, quality, and access to valued data and information. • Taken together, this can lead to better, more efficient care and more predictable payments in the future.
Sweet, K., et al (2017) **(36)**	To look if genomic counseling for patients suffering from chronic disease (heart failure, hypertension) impacted records related to patient-physician communication over genomic test results after the test report was uploaded	Randomized controlled trial	Ohio State University-Coriell Personalized Medicine Collaborative (OSU-CPMC) academic medical center	November 8, 2011 - August 22, 2014.	• Multivariate Logistic regression was used for analysis here. • The study tried to understand the effects of genomic counseling in provider-patient communication. •

	to the electronic medical record, or after the patient met with a genomic counselor.				
Yi, S. S., et al (2015) **(37)**	This study looks for the importance of EHR to assess the effectiveness of self blood pressure monitoring in controlling hypertension in minor, urban communities	Randomized clinical trial	Community city clinics of New York City partnered with New York City Health department	June 7, 2010-October 7, 2011.	• This study looked at the effect of giving self-blood pressure monitors to a mostly Hispanic, foreign-born, and uninsured populations and discovered that it was not more effective than usual care in these groups.

Table 3.1 Summary of included articles with key findings

Chapter 4: Discussion

4.1 Evidence showing the functionalities of EHR

Although the effectiveness of EHR technology is sometimes questioned in the healthcare industry, current research demonstrates that EHR systems can enhance the management of chronic diseases, leading to better patient health outcomes and, in the long run, less work for physicians. EHR functionalities are derived from our systematic findings above **(Table 4.1)**.

EHR Functionalities	**Examples**
Record population data **(38)**	Big data platforms make it quicker and cheaper to compile huge population datasets than traditional cohort research methods, which specifically improves the effectiveness of observational studies. Contrarily, machine learning techniques are increasingly popular in clinical analysis due to their tremendous capacity to apply sophisticated mathematical processes to calculate massive volumes of data. Many clinical research would become significantly more feasible in terms of data availability if retrospective population data from electronic health record (EHR) big data systems could be extracted and analyzed.
Record vital signs and list of problems, list of medication, list of allergy **(16)**	EHRs and other similar patient management software-systems, according to Richter et al., have the potential to support contemporary treatment concepts (such as the tight control), as they allow for the time-marked, in-time flagging of significant, clinically related symptoms that could be readily examined (in defined intervals of time) to gain broader perspectives on specific courses of disease.
Capture smoking status **(39)**	Smoking increases the risk of lung cancer and cardiovascular disease. The utilization of Electronic Health Records (EHRs) to facilitate cessation of smoking, with a focus on recording and tracking tobacco use and offering cessation support as the intervention.
Drug interactions **(40)**	Multiple drugs are often prescribed for chronic illnesses, which raises the possibility of harmful drug interactions and drug allergies. EHR systems must be utilized as an alternative method of evaluation of drugs to outline risks from medicinal uses and interactions before any serious problem arises.
Information exchange capabilities and data submission capabilities **(16) (41)**	For patients with CKD to receive the best care possible, information interchange between healthcare settings and between physicians is essential, yet records are currently disjointed. For instance, it is not common practise to connect clinical data from dialysis facilities with

	the health records of other providers. Information interchange might be broadened such that the CKD data could be mapped across providers and treatment settings to promote continuous flow of care which potentially, could save a lot of costs. However, this would require the right safeguards to preserve patient privacy.
CDS (Clinical Decision Support) **(42) (36)**	The impact of computerized, knowledge-based CDSS on clinical results related to the patients with chronic diseases handled in primary care settings as well as patient-reported outcomes.
Incorporate laboratory results **(23)**	EHR systems are now integrated as computerized laboratory ordering. Since laboratory utilization trends might differ quickly, it is crucial that these reports be produced in a timely way (for example, the following day). This could be particularly true if an EHR mapping or menu updating error occurred that unintentionally had a major and immediate impact on ordering laboratory tests.
Generate patient lists for quality improvement **(43)**	Some facilitators assisted practices in developing patient lists to identify at-risk patients, evaluate patient progress, and schedule future patient visits. Facilitators talked about manually tracking improvements and estimating performance measures for practices without performance measures, nevertheless.
Identify patient-specific educational resources **(44)**	The development of a single unique educational intervention to address the lack of type 2 translational research and to enhance the management of CKD (chronic kidney disease) patients. The goal of the CKD patient navigation programme is to educate and empower fellow patients and their related care team utilizing the development of skills based on the patient navigator and related experiences in the field of oncology, but using significant modifications related to CKD and the chronic behavior of the condition at hand.
Summary of care record for care transitions **(22)**	According to a 2011 study, poorly planned transitions from hospitals to alternative care settings cost between $12 billion and $44 billion annually and frequently have negative health effects when the priority is to solidify the quality of care while more efficiently using resources, efficient transitional care can nullify medical errors and outline problems for prior intervention thereby preventing need of hospitalizations/ readmissions which in turn would support consumers' priorities and choices and prevent redundancy of services.
Vital data source for research	Permits studies on bigger samples (representing a reliable national sample) and connections between clinic related information and symptoms with significant lags between exposure and outcomes, exposures that may alter over time, and/or secular trends (e.g. concerning medication regimes) in chronic conditions).

Reminders/Alerts for preventative and follow-up care **(32)**	Patients with chronic diseases need to recall more things than those with patients with uncomplicated diseases. The EHR system's implementation of alerts or prompts helped to boost screening rates, expedite specialized referrals, and boost the population's chronic illness management.
Providing access of data to the patient (personal health related records, portals) **(17)**	Patients can access their health-related data just by using their EHR. Patients may benefit from this information's transparency by ensuring the validity of the data stored (e.g., by understanding invalid or erroneous data related to medication). Additionally, the same can increase patient empowerment by allowing patients to monitor their test values and help them better manage their care. It can help improve patients' adherence (e.g., with respect to intake of medication or specific adherence to guidelines). This might ultimately result in enhanced clinical outcomes.

Table 4.1 EHR applications for managing chronic diseases and the functional requirements for meaningful use

4.2 Evidence showing the diminished role of present EHR systems

According to a 2015 study by Newman et al., there are various numbers of given limitations along the current generation of Electronic Health Records (EHRs) that make them less than ideal for patients with chronic rheumatic diseases. Some of these limitations include the absence of outcome measures and the time-consuming documentation requirements (**45**).

Even though customers wanting to pay using a paper check are much less in 2020, eighty-six percent of patients made sure they received a paper bill of their medical expenses. In order to receive adequate care, patients frequently need to request hard copies of their medical records from pharmacists, eye physicians, and dentists in order to receive proper care. Numerous healthcare professionals still converse with patients on paper. Even though studies suggest that greater patient communication can help improve the outcomes thereby reducing rate of readmission, appointment reminders and medical invoices are still often mailed to patients. There is no getting around the truth that healthcare sector depends heavily on paper. This is partially due to the fact that some systems cannot establish consent forms with needful signatures, check-in or belongings forms related to the patients, and other documents. The major number of prescriptions and pharmaceutical records are now written using pen and paper.

Specialists, pharmacists, and other professionals occasionally need to see patients outside of a health system. But extensive patient's medical records and lab test results must be provided via paper when external organizations don't use the same EHR. Hospitals frequently run into problems like this. The adoption of EHR systems was intended to simplify the process of patient data management, however there are a wide number of EHR options available today, and they don't seem to communicate well with one another. This is a crucial and much debated topic. Without an effective workflow for data exchange, clinicians must reassess patient histories, occasionally repeating invasive tests or making choices about patient care based on insufficient data. Health Services as well as Human Services are currently seeking to enforce simultaneous operations by fining businesses who consciously prevent information sharing. It is challenging to demonstrate willful wrongdoing, nevertheless. Of course, an individual, integrated EHR system can be regarded as the best option, an option that the Department of Veteran's Affairs is tackling. However, clinicians will need another remedy for this pervasive issue until we can achieve such a condition of interoperability.

4.2 Suggested windows of opportunities

- The ultimate aim, or "big data" scenario, is an integrated EHR with standard clinical data from various healthcare records, new biomarker results, and behavioral and contextual data from linked devices. A person's specific characteristics are probably a stronger indicator of future risk of adverse outcomes and of their propensity to respond to particular therapies.

- EHRs are relatively excellent with the "record" aspect — keeping a record as to what has occurred to the patient. They must develop to meet the "health" component by assisting doctors in making plans utilizing EHR as a marketing tool:
    - **A collection of care plans that address a variety of circumstances.** Plans would need to change depending on the conditions and preferences of the patient. A patient who has their diabetes under control would consider having a different strategy than the one who would still be having trouble. Patients who have lived alone can be considered to have some other strategy than a patient who had a big, loving family.
    - **Using algorithms to create a patient's overall strategy.** Rarely do patients have only one distinct, manageable problem. To treat a patient having problems like

asthma, depression, arthritis and weight loss, for example, a master plan would integrate the necessary algorithms, automatically removing complications and duplicates.

- **Aid from the care staff.** Each team member would have access to both the superior plan as well as their personal to-do items, including the patient, specialists, nurse practitioners, pharmacists, and case managers. Tasks could be distributed among the team members.

- **The capacity to move across different EHRs, locations, and care settings.** The strategy would have to move fluidly alongside the patient. Regardless of where a patient's plan originated, providers would have systems that were compatible and could integrate it.
- **Workflow and decision support.** The system needs to send alerts/updates to the needful team member with respect to the new test findings or patient relevant events as well as remind team members of future and past-due tasks. It also needs to suggest adjustments to the plan as patient circumstances or care requirements change.
- **Analytics for both demographics and individual patients.** When both specific patient and the potential broader population under the care of the provider is considered, the system must be capable of evaluating how well the plan is accomplishing its objectives. It needs to be able to use the knowledge gained from treating one patient to help other patients.

Instead of viewing the EHR as a single document, we must rethink it as a unified system that enables creation and monitoring of numerous documents, activities and events. In order to guarantee clinical appropriateness and effective execution, it must cater to all transactions and related clinical process with utmost intelligence.

Chapter 5: Conclusion

Our systematic literature analysis readily identifies the important disparities with respect to EHR study and its relevant findings, at the same time outlining similar opportunities for advancements that have been proposed by various number of studies, trials, and systematic reviews that has been published previously. Studying the methodological challenges and limitations that have been acknowledge by authors in some publications, researchers can thereby recheck the results of particular EHR elements on a various resulted metrics. As a result, they will be able to develop improved clinical processes, technology innovations, advantages of EHR software, and workflow processes.

Due to a lack of consensus and conflicting findings in the numerous studies that have attempted to quantify benefits including improved treatment quality, data monitoring, cost savings, and a decrease in medical errors, the true effects of EHR are generally unappreciated. EHRs can go further about understanding of diseases in addition to their clinical benefits by providing rich data for observational research and locating suitable study participants. EHRs can also provide thorough data to national surveillance systems, allowing for the creation of more specialized strategies to improve public health standards. The promise of EHRs to enhance chronic illness care and research has not yet been fully explored due to its limitations in design and implementation, particularly in our nation. If we want to raise the safety of diagnosis, it will be vital to understand and utilise the major benefits of the EHR that relate to diagnosis as well as comprehend and address any potential future drawbacks.

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