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Developing Strategies For Adopting And Implementing Electronic Medical Records/Electronic Health Records: A Comparative Analysis Between Low-Middle-Income And High-Income Countries

Martha. I. Odoemene
(University College, University Of Denver, United States)

Abstract:
Background: *Electronic Medical Records (EMRs) and Electronic Health Records (EHRs) are vital in modern-day healthcare delivery. While some countries have substantially developed its usage in healthcare delivery, other countries are yet to appreciate it and adopt it for usage.*
Materials and Methods: *This research did a comparative study on the extent of adoption and implementation of EMR/EHR in health care delivery in low-middle-income (LMICs) and high-income countries (HICs) using twelve countries as a case study. The study employed and used relevant literature and existing data on the use of EHR/EMR in these countries with a comparative overview.*
Results: The *findings obtained revealed that HICs have been more successful due to their robust infrastructure, advanced healthcare system, resources, policies, and change management strategies. In contrast, LMICs face infrastructure and policy limitations.*
Conclusion: *The potential strategies for adopting and implementing EHR/EMR in LMICs and its consolidation in HICs were developed to accommodate the specific needs of each country.*
Keyword: *Electronic Medical Record (EMR)/Electronic Health Record (EHR), Adoption, Development*

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I. Introduction

Background to the Study

The medical record has been an indispensable aspect of healthcare delivery since the advent of healthcare. Medical records are used for various purposes, including diagnosis, treatment, statistics, and research. With the evolving world of technology, there is a need to keep medical records in a retrievable format and share the same using an interface hence the introduction and use of electronic medical/health records. With the need for healthcare providers to comply with rules and standards set by regulatory agencies coupled with pressure from competition and the quest to deliver quality healthcare for patients, the need for the use of EMRs/EHRs, therefore, becomes very crucial. EMR has been used to describe automated systems that are based on document imaging or systems developed within a medical practice or community health center and are used extensively by medical practitioners in many developed countries to identify patients' details, medications, prescriptions, and other related records[1]. EMR allows the electronic entry, storage, and maintenance of digital medical data. EHR on the other hand is a longitudinal electronic record of the health information of a patient which is generated by one or more encounters in any healthcare delivery encounter. EHR contains information such as the patient's demographics, problems, progress notes, vital signs, medications, previous medical history, immunizations, laboratory data, and radiology reports. [2]. EMR and EHR are most of the time used interchangeably. EMR is an EHR element comprising patient registration, billing, check-ups, or preventive screenings. EMR also consists of; patient appointment and scheduling, tracking of patient data over time, monitoring, and overall improvement of quality care.[3]. In any case, both EMR and EHR for this study serve the same purpose and will be used interchangeably. They serve the same purpose of automating and streamlining a clinician's workflow while supporting other care-related activities directly or indirectly through an interface, quality management, and reporting of outcomes. There are numerous benefits of using EHR/EMR in healthcare delivery such as patient documentation, fostering quality assurance in medical processes, convenience, and efficiency, tracking of patient utilization and healthcare cost, reporting of quality healthcare data to government and health-related agencies, portability of health records and easy sharing of health records between healthcare providers.[4]. A computer program is required in the use of EMR/EHR to capture data at the time and place where patients access healthcare, whether at a primary healthcare level or at a hospital over an extended period. This will enable healthcare information like allergies, recent test results, or

prescribing history to be readily available to aid decisions on diagnosis, treatment, and medication at all levels of healthcare delivery.

In HICs, the adoption of EMRs/EHRs has been more successful with many national healthcare systems mandating the adoption of EMRs/EHRs to improve healthcare quality and efficiency in HICs.[2]. Countries such as the USA, UK, Australia, New Zealand, Israel, Germany, and some European countries have long adopted the use of EHR/EMR to promote healthcare delivery while ensuring that care given to individuals by various healthcare practitioners from different settings in their lifetime is maintained in a single readily available record.[1]. Conversely, the adoption of these systems has been slow in many LMICs, where healthcare systems often lack regulatory frameworks, resources, and infrastructure needed to support these technologies. This is due to ignorance, lack of funds, and manpower capacity. [5].

Statement of the Problem

Globally different countries have tried to adopt and implement EHR resulting in a 46% increase in EHR use in the past six years.[4]. Despite the enormous benefits of using EHR and EMR in healthcare delivery, adoption of these systems has been slower in LMICs, especially the sub-Saharan countries and just 15% of LMICs are said to have nationally adopted electronic records in healthcare organizations compared to HICs. [4,6,7]. In contrast, the OECD iLibrary, (2018) revealed that 93% of primary care practices use EMRs in HICs and currently, the CDC/National Health Statistics, (2023) revealed that 88.2% of office-based physicians use EMRs/EHRs in the US and 77.8% of office-based physicians have certified EMR/EHR systems.[8,9]. The slow adoption of EMRs/EHRs in LMICs is concerning because sub-Saharan Africa represents 12% of the global population and faces 25% of the world's disease burden.[10]. Also, some countries that adopt EHR/EMR are faced with challenges that serve as an encumbrance to its effective usage. Some of these challenges include high cost, resistance to change, slow systems/poor networking speed, system crashes, activities of hackers and internet fraudsters, privacy, and confidential issues.[11,12]. To address these challenges and improve healthcare quality and access in LMICs, it is crucial to understand the strategies that have been efficient in mitigating barriers to EMR/EHR adoption.

This study is intended to consider the healthcare practice of different countries of the world and develop implementation strategies on how to adopt the use of EMR and EHR in healthcare delivery with the view of comparing LMICs and HICs while proffering solutions to the nagging problems encountered. The study will focus on six LMICs: Ethiopia, Kenya, Malawi, Nigeria, Bangladesh, and Ghana, and six HICs: Australia, Canada, Germany, Israel, the United Kingdom, and the United States. By selecting these countries, a wide range of socioeconomic and cultural contexts that affect the implementation of EMR/EHR systems will be identified.

Objective of the Study

The study's general objective will be to develop implementation strategies for adopting EMRs/EHRs through a comparative analysis between LMICs and HICs. The specific objective will be to:

1. Identify the challenges and opportunities in the adoption of EMRs/EHRs in LMICs and HICs.
2. Analyze the existing implementation strategies for EMRs/EHRs in LMICs and HICs.
3. Compare the effectiveness of implementation strategies for the adoption of EMRs/EHRs in LMICs and HICs.
4. Develop effective implementation strategies for the adoption of EMRs/EHRs in LMICs.
5. Make recommendations on how to enhance the use of EHR/EMR in defaulting countries.

Research Questions

The following research questions will be answered:

1. What are the key challenges faced by LMICs in implementing EMR/EHR systems, and how do they differ from those faced by HICs?
2. What are the current EMR/EHR implementation strategies in LMICs and how do these strategies differ from those used in HICs?
3. How do social and cultural factors affect EMR/EHR adoption in LMICs and HICs?
4. What are the potential benefits and risks of EMR/EHR adoption in LMICs and HICs?

Scope of the Study

The scope of this study is to examine and compare the implementation strategies for the adoption of EMRs/EHRs in six low-income countries and six high-income countries. The study will focus on the identification of the key factors that influence the adoption of EMRs/EHRs in the selected low-income and high-income countries which include Ethiopia, Kenya, Malawi, Nigeria, Ghana, Bangladesh, Australia, Canada, Germany, Israel, and the United Kingdom. This study will draw data from literature reviews to gather comprehensive information and analysis on the similarities and differences in the adoption and implementation of EMRs/EHRs in the selected countries.

Significance of the study

This study is significant because it will contribute to the improvement of healthcare quality efforts and access in low-income countries where innovative solutions are needed for significant health challenges. According to Lin et al. (2020), EMRs/EHRs have been proven to reduce medical errors by 30% and improve healthcare outcomes.[13]. However, different challenges have slowed their adoption in low-income countries. Therefore, identifying strategies for implementing and adopting EMR/EHR in low-income countries will provide insight to policymakers, healthcare providers, and other stakeholders on how to mitigate these challenges. Also, the study will highlight a comparative analysis of EMR/EHR in low-income and high-income countries, which will help identify similarities and differences in the approach utilized in these countries. Consequently, policymakers and healthcare providers will be able to learn from the experiences of high-income countries and apply them in low-income countries where needed. In addition, the study will contribute to the body of knowledge on the adoption of EMR/EHR, especially in low-income countries. Due to inadequate research on this topic, the findings of this study will provide valuable insights for the research and development of EMR/EHR adoption strategies in low-income countries in the future. Overall, this study has the potential to improve healthcare outcomes and access in low-income countries, for example, HICs have achieved a reduction in healthcare costs by 15% due to reduced paperwork and organized workflow, unlike LMICs which have minimal cost savings of 1%.[14]. Therefore, this study will contribute to the development of effective implementation strategies for the adoption of EMR/EHR in these countries.

Operational Definition of Terms

The following terms will be operationally defined in this study as thus:

1. Adoption: The process of accepting and integrating a new technology, system, or practice, in this case, the use of electronic medical/health records (EMRs/EHRs) in healthcare systems.
2. Implementation: The process of putting a plan or strategy into action to achieve a specific goal or objective, such as the implementation of EMRs/EHRs in healthcare systems.
3. Strategies: A set of actions or methods designed to achieve a specific goal or objective, such as the development of implementation strategies for EMR
4. /EHR adoption in low-income and high-income countries.
5. Electronic Medical Record (EMR)/Electronic Health Record (EHR): Digital versions of a patient's medical record that can be accessed by authorized healthcare providers. EMR and EHR will be used interchangeably in this study, although EHR is typically more comprehensive and may include additional information, such as patient demographics and billing information.
6. High-income countries: Countries with a high level of economic development, typically characterized by high levels of gross national income (GNI) per capita, in this case, the United States, Canada, Australia, Germany, Israel, and the United Kingdom.
7. Low-income countries: Countries with a low level of economic development, typically characterized by low levels of GNI per capita, such as most countries in sub-Saharan Africa and South Asia, in this case, Ethiopia, Kenya, Malawi, Nigeria, Sierra Leone, and Zimbabwe.
8. Implementation strategies: Specific plans or approaches designed to facilitate the successful adoption and integration of EMRs/EHRs in healthcare systems.
9. Development: The process of improving or advancing a particular area or field, such as the development of implementation strategies for EMRs/EHR adoption in low-income and high-income countries.

II. Review of Literature

Introduction

Digital technology has affected the way people live, work, study, and interact with each other. Each industry is forced to keep up with the rapid advancements in technology and healthcare is not exempted. At the center of this digital transformation in healthcare are the EMRs/EHRs. EHR is a worldwide initiative to eradicate paper documentation.[15]. Medical records started in 1600 BC in the form of concise written case reports such as injuries, fractures, wounds, dislocations, and tumors. It was used mainly for teaching. But in 1862 case reports were written on papyrus by Edwin Smith, an Egyptologist. However, bedside patient recording commenced in 1898, transitioning from retrospective documentation to actual time case reports of family history, patient habits, previous illnesses, present illnesses, physical examination, admission time, blood analysis, progress notes, discharge diagnosis, and instructions.[16,17]. Therefore, the adoption of EMRs/EHRs has been recognized as a critical step toward the modernization of healthcare delivery and improvement in patient care outcomes globally. It also has the potential to revolutionize the healthcare industry by improving the coordination of patient care, reducing medical errors, and enhancing the efficiency of healthcare. However, EMRs/EHRs adoption has been uneven across different countries, with LMICs facing distinctive challenges due to resource constraints, technical limitations, and sociocultural factors.[18].

Overview of Selected Countries Health Systems, Definition, and History of EMRs/EHRs

In Australia, a universal public health insurance program called "Medicare" is administered per region and is financed through a government levy and general tax revenue. Citizens are enrolled automatically while New Zealand citizens, permanent residents, and others from countries with reciprocal benefits are also eligible to enroll in Medicare. The services rendered include free hospital care and significant coverage for physician services, pharmaceuticals, and other services. Meanwhile, the total Australian population is 24.6 million as of 2020, and the population of individuals aged 65 and above is 15.6%. the capacity and utilization of the health system include 3.7 practicing physicians per 1,000 population, an average physician visit per person is 7.7, while nurses 11.7 per 1,000 population with 3.8 hospital beds per 1,000 population and 181 discharges per 1,000 population. Healthcare spending per capita is $5,005 (USD purchasing power parities), out-of-pocket spending per capita is $837, while $673 spending is on pharmaceuticals (prescription and over-the-counter (OTC)) per capita. In addition, life expectancy at birth (years) is 82.6, obesity prevalence is 30.4%, diabetes prevalence is 5.1% and 15% of adults live with 2 or more multiple chronic conditions. Public insurance covers 100% of the population. On the other hand, private supplementary coverage for individual policies for dental, vision, physiotherapy, chiropractic, and home nursing is 55% while individual policies for access to private hospitals are 46%. Half of Australians buy private supplementary insurance to pay for private hospital care or other services. Although the federal government pays a rebate for this premium tax penalties are charged on households who earn higher income and refuse private insurance premiums (The Commonwealth Fund, 2023).

History, Adoption, and Status of EMRs/EHRs In Australia

The history of EMRs/EHRs in Australia can be traced back to the 1990s when the country began to explore the potential of digital health technologies and the national digital health strategy is the responsibility of the Australian Digital Health Strategy created in 2016.[19.] The overview of the major milestones in the development and adoption of EMRs/EHRs in Australia are highlighted below:

1. The 1990s-2000s: early initiatives were started and several small-scale projects such as the General Practice Management System (GPMS) were initiated to digitize health records and improve information sharing among healthcare providers. The aim was to automate administrative processes in general practice.[20].
2. 2005: Personally Controlled Electronic Health Record (PCEHR) system was introduced and was later renamed "My Health Record." Which was a government-led initiative designed to centralize digital health record systems for individuals to store and share their health information with their healthcare providers.[21,22]. However, PCEHR was slow; as of 2016, only 2% of the Australian population had a PCEHR.[23].
3. 2010: The National E-Health Strategy was launched to promote interoperability and exchange of information among healthcare providers and to encourage the implementation of EMRs/EHRs in different healthcare organizations.[22].
4. 2011: the National Health Identifier (HI) System was implemented, and a unique identifier was assigned to every individual accessing healthcare services in the country. The HI system was the bedrock for the development of EHRs and it enhanced the accurate identification of patients and their records across different healthcare systems and providers.[24].
5. 2012-2014: EHRs in public hospitals implemented. The initiative was known as the National eHealth Transition Authority (NEHTA). It was aimed at the replacement of paper records with digital records, clinical documentation improvement, and enhancement of communication and coordination among healthcare providers.
6. 2016: Opt-out Model for My Health Record commenced. The country transitioned from an opt-in model to an opt-out model for the My Health Record System. Individuals are automatically included in the My Health Record System unless they actively choose to opt out. This is to improve the adoption and use of EHRs.[23].
7. 2018-2020: My Health Record and Interoperability efforts expanded to include features like uploading pathology and diagnostic imaging reports, electronic prescriptions, medical notes, referrals, and shared health summaries. Also, patients can view their records, determine who sees them, and update their information such as adverse reactions, and advance directives.[22,24].

Presently, the adoption and evolution of EMRs/EHRs continue to evolve in Australia. Both public and private healthcare organizations are implementing EMR/EHR systems to digitize health records, streamline workflows, and improve patient care. Additionally, the Australian EHR market contributes significantly to the global numbers. It was valued at US 526.3 million dollars in 2018, and 8.5% of an annual compound growth rate (CAGR) is expected from 2019 to 2025, which is 38 billion US dollars (Writer, 2019). Currently, over 6 million patients (i.e., one-quarter of Australians) and 13.4 million providers are currently enrolled in the national e-health program.[24].

The Canadian Health Care System Overview

Canada runs a decentralized, universal health system called the "Canadian Medicare" which is publicly funded. However, each of the 13 provinces and territories funds its health care and owns its own insurance plan,

but the federal government gives cash assistance to provinces and territories per capita, therefore benefits and health care delivery approaches differ. The total population of Canadians as of 2020 is 36.7 million and the population of the elderly age 65 and above is 17.3%, 2.7 practicing physician visits per 1,000 population, 6.8 average physician visits per person, 10.0 nurses per 1,000 population, and 2.5 hospital beds per 1,000. Healthcare spending per capita is $4,974, out-of-pocket health spending per capita is $749, and pharmaceutical spending on pharmaceuticals (prescription and OTC) per capita is $806. Furthermore, life expectancy at birth (in years) is 82.0, obesity prevalence accounts for 26.3%, diabetes 7.4%, and 22% of 2 or more adults live with multiple chronic conditions. It is worth noting that all citizens and permanent residents receive health care services for free at the point of care except for excluded services such as dental care, and outpatient prescribed drugs. However, provinces and territories provide coverage for targeted groups and two-thirds of Canadians use private insurance.[24].

History, Adoption, and Status of EMRs/EHRs In Canada

Over the years, the uptake of health information technologies has been increasing slowly in Canada. The development of electronic health information systems is the responsibility of provinces and territories with national funding support through the Canada Health Infoway. Although there is no stipulated national strategy for the implementation of EHRs and no national identification of patients. However, the Canada Health Infoway revealed that each province systematically collects data electronically for its population. Here is an overview of major events and timeline of EMR/EHR use in Canada:

1. The 1980s: Early adoption of Computerized Patient Record Systems for administrative functions such as patient registration and billing started. However, these early systems were not widely adopted due to limitations in their functionality.[25].
2. The 1990s: Canadian provinces and territories commenced their own EMR/EHR initiatives to improve patient care and information management. For example, the Alberta Netcare System was launched in 1999 to create a province wide EHR system for sharing patient health information among healthcare providers. (https://www.albertanetcare.ca/)
3. 2001: Canada Health Infoway was established. It was a federal, not-for-profit organization created to expedite the development and adoption of EHRs and other digital health solutions in Canada. Canada Health Infoway has enhanced the coordination and funding of EHR initiatives in different provinces and territories.[26].
4. 2007: The launching of Canada's First Fully Implemented EHR System called the Nova Scotia Electronic Health Record (NS EHR) was in 2007 in Nova Scotia. It was aimed at providing a single, integrated EHR for patients in all parts of the provinces with the inclusion of administrative and clinical information.[26].
5. The 2010s: there was an expansion of EHR adoption across Canada. EHR initiatives were implemented in various provinces and territories to improve patient care coordination, enhance clinical decision-making, and allow secure patient information exchange among healthcare providers. Examples include British Columbia's eHealth Strategy, Ontario's eHealth Ontario, Quebec's Dossier Santé Québec, and others.
6. 2017: Pan-Canadian Standards for EHRs were released by Canada Health Infoway in 2017 to provide a common set of standards and specifications for EHR systems in Canada. The aim was to promote interoperability, data exchange, and consistency in the implementation of EHR and improve the seamless sharing of patient information across jurisdictions and healthcare providers. Eighty-five percent of General Practitioners (GPs) were reported to be using EMRs in 2017, but patient access to their electronic health information is limited.[27].

Now, EHR adoption and use are still emphasized across healthcare systems in Canada, but interoperability remains an issue. [28] revealed the rate of EMR usage in Canada as of 2021 by primary care physicians according to province/region to be 95% in Saskatchewan, 90% in Ontario, 89% in Alberta, and British Columbia, 84% in Manitoba, 75% in Quebec, and 74% in Atlantic Canada. Ongoing efforts are aimed at the expansion of EHR initiatives, promotion of interoperability, and addressing privacy and security concerns.[29].

Overview of the German Healthcare System

The German healthcare system runs a mandatory healthcare system where approximately 86% of the total population of 82.7 million as of 2020 are enrolled in statutory health insurance (SHI), The SHI provides services such as prescription drug coverage, inpatient, outpatient, and mental health which is administratively handled by sickness funds: nongovernmental insurers. The government itself does not offer direct delivery of healthcare. The population of the aged over age 65 is 21.4% and the health system capacity and utilization consist of 4.3 practicing physicians per 1,000 population, 9.9 physician's visits per person average, 12.9 nurses per 1,000 population, 8.0 hospital beds per 1,000 population, and 255 discharges per 1,000 population. Therefore, funding for sickness funds is financed through general wage contributions and statutory coverage covers 88% of the population while 11% of the remaining population is covered by private substitute coverage where Germans that earn more than 68,000 US dollars are requested to opt out of SHI and government subsidies does not apply to private insurance. Consequently. Healthcare spending per capita is $5, 986, while out-of-pocket spending is $738 per capita, and pharmaceutical spending including prescription and OTC per capita is $823. Overall, the health

status and disease burden in Germany is rated at 81.1 life expectancy at birth (years), the prevalence of obesity is 23.6%, diabetes prevalence is 8.3%, while 17% of adults live with 2 or more multiple chronic conditions as of 2020.[24].

History, Adoption, and Status of EMRs/EHRs In Germany

The concept of EHR in Germany began with the development of computerized systems for the management of patient information in hospitals and healthcare facilities in the 1980s-1990s. Significant events in the history of EMR/EHR in Germany are highlighted below:

1. 2003: The Electronic Health Card (Elektronische Gesundheitskarte or eGK) was introduced to maintain a standardized and interoperable system for storing and exchanging electronic patient health information.[30].
2. 2006: Telematics Infrastructure (TI), a technical framework for the exchange of electronic health information was implemented by the government. It includes components such as the Electronic Health Professional Card (eHPC), the Electronic Health Card Terminal (eGK-T), and the Healthcare Provider Directory (HPD), to maintain secure and interoperable communication among stakeholders.[30,31].
3. 2012: The concept of Electronic Patient Record (Elektronische Patientenakte or ePA) was introduced to allow for a comprehensive patient centric EHR system.[30].
4. 2015: Nationwide use of electronic medical chip cards by all statutory health insurance (SHI)-insured commenced. Information such as the individual's name, address, date of birth, sickness fund, details of insurance coverage, and individual's status for supplementary charges are encoded and patients decide if clinical data such as are to be stored or sent to their physician. Also, the Parliament passed a law in 2015 called the "E-Health Act" to secure digital communications and healthcare applications. For example, deadlines are set for documentation of organ donation willingness, and incentives and sanctions are introduced if schedules are or are not met.
5. 2016-2017: Additional fees are given to SHI physicians who share electronic medical reports with other providers.

8. 2018: Collection and documentation of emergency records, and management and review of basic insurance online data claims were rewarded. Additionally, to maintain safety in drug therapy, patients who use at least three prescribed drugs simultaneously are placed on individualized medication plan which is included in the EMR. Therefore, SHI physicians who do not engage in an online review of data claims of basic insurance are likely to receive minimal remuneration in the future.[30,32].

Israel's Healthcare System Overview

The total population of Israelis is 8.7 million as of 2020, and Israel offers universal healthcare coverage to its citizens, therefore national health insurance which consists of compulsory insurance funded through income and health taxes offered by four private nonprofit plans covers 95% of the entire population, 2% of the population are uninsured, while 3% are covered by private insurance and this is for foreign workers, army, or prison service healthcare. The population of adults over 65 years of age is 11.7% and the health system capacity and utilization consist of 3.1 practicing physicians per 1,000 population, 5.1 nurses per 1,000 population, 3.0 beds per 1,000 population, and 154 discharges per 1,0000 population. Furthermore, the life expectancy at birth in years is 82.6, obesity prevalence is 18.8%, and diabetes prevalence is 6.7%. Therefore, healthcare spending per capita is $2,780, and out-of-pocket spending per capita is $593 while spending on pharmaceuticals including prescription and OTC per capita is $310.[24].

History, Adoption, and Status of EMRs/EHRs In Israel

The penetration and use of EMR/EHR in Israel are dynamic and efficient. [33] revealed that the management of patient information in Israeli healthcare facilities started in the 1980s and 1990s, and all health plans have EHR systems that link all community-based providers, primary care physicians, specialists, laboratories, and pharmacies together, and all GPs use EHRs. Citizens have a patient ID and patients have the right to request copies of their medical records from health plans and hospitals. Also, patients can schedule appointments online and have access to lab test results. However, full medical records are not available to patients. A major national health information exchange project led by the Ministry of Health is ongoing to allow systems to share relevant information across health plans and hospitals and to set up secure messaging systems that will link patients to their GPs [24].

Overview of the United Kingdom's Healthcare System

The total UK population is 66.1 million as of 2020 with 18.2% of the population over age 65. All residents are provided with free public health care services such as hospitals, physicians, and mental health through the National Health Service (NHS). The public health insurance coverage is 100% while private coverage is 10.5% for voluntary and supplementary coverage for more rapid access to elective care and other services. The NHS is funded through general taxation and the healthcare spending is $4.070 per capita, with $629 out-of-pocket health

spending per capita, and $469 spending per capita on pharmaceuticals including prescription and OTC. Furthermore, the health system's capacity and utilization comprise 2.8 practicing physicians per 1,000 population, 7.8 nurses per 1,000 population, 2.5 hospital beds per 1,000 population, and 131 hospital discharges per 1,000 population. Overall, life expectancy at birth in years is 81.3, with 28.7% obesity prevalence, 4.3% diabetes prevalence, and 14% of adults living with 2 or more multiple chronic conditions.[24].

History, Adoption, and Status of EMRs/EHRs In the United Kingdom

The history of EMRs/EHRs in the UK healthcare system can be traced back to the early 2000s when the National Health Service (NHS) which is a publicly funded healthcare system in the UK initiated the digitalization of patient health records to transition from paper-based records to electronic systems.[34,35]. The UK has made significant progress in the adoption and implementation of EMRs/EHRs over the years through government initiatives, policies, and advancements in technology as every registered patient has a unique identifying number assigned by the National Health Service (NHS) in England. The events are highlighted below:

1. 2002: The National Programme for Information Technology (NPfIT) was launched and aimed at the modernization of the NHS IT infrastructure and the introduction of digital health records across the country (Justinia 2017, 3). The foundation for the adoption EMRs/EHRs in the UK was laid by the NPfIT to have a centralized electronic health record for all patients in England.
2. 2007: The Summary Care Record (SCR) was launched in 2007 which is one of the key milestones in the history of EMRs/EHRs in the UK (Summary Care Record, 2023). The SCR is referred to as the electronic summary of an individual's health information like medications, allergies, and adverse reactions. To provide more coordinated and safer care, authorized healthcare professionals are allowed access to all this information.
3. 2013: The Care.Data Program was initiated by the NHS to extract data from patients for the purpose of research through different sources with the inclusion of EMRs/EHRs. However, the program was suspended in 2016 due to privacy and security concerns, but the relevance of governance and security of data in the adoption of EMRs/EHRs was emphasized.[36]. According to [24] all patients' medical records are computerized, and patients are allowed to schedule appointments and order prescriptions online since 2015. Also, patients were allowed access to their detailed coded records such as information about diagnoses, medications, treatments, immunizations, and test results since March 31, 2016. However, patients are not allowed access to clinicians' information in free-text fields but can request a paper copy of their medical records if electronic copies are not available in some specialties such as dentistry.
4. 2018: The General Data Protection Regulation (GDPR) was implemented in 2018 to strengthen data protection, privacy regulations, and management of patient data using EMRs/EHRs. Also, the NHS launched the NHS App, which allows the booking of appointments, orders of prescriptions from smartphones, and medical record access by patients.[24]. Secure exchange of patient data through the Application Programming Interfaces (APIs) and open standards are promoted by the NHS to enable interoperability. Therefore, in October 2018, all NHS providers started receiving referrals to outpatient services electronically from GPs and the NHS started a paperless system across primary, urgent, and emergency care services in 2020. Patients register with their GP, schedule appointments, order prescriptions, access digital tools and approved apps, and get information on local services and health in general through a single NHS website and this website is being upgraded to allow patients to access their doctors online or through a video link for their full medical records.

The Overview of the United States Health System

The United States with a population of 325.7 million and 16.0% of the aged population runs a mix of public and private health systems for private and nonprofit insurers and health care providers. Private and public insurance covers 91.5% of the population which includes public (34% of Medicare, Medicaid, Children's Health Insurance Program (CHIP), and military insurance) and private (67% of employer plans, and direct purchases). However, 8.5% of the population is uninsured as of 2020 (The Commonwealth Fund, 2023). The US health system's capacity and utilization comprises 2.6 practicing physicians per 1,000 population, 4.0 physician visits per person, 11.7 nurses per 1,000 population, 2.8 hospital beds per 1,000 population, and 125 hospital discharges per 1,000 population with $10,586 health care spending per capita, $1,122 out-of-pocket health spending per capita, $1,220 spending on pharmaceuticals. In addition, health status and disease burden comprise 78.6 life expectancy at birth years, 40.0% of obesity prevalence, 10.8% of diabetes prevalence, and 28% of adults living with 2 or more multiple chronic conditions.[24].

History, Adoption, and Status of EMRs/EHRs In the United States

In the US, the Office of the National Coordinator for Health Information Technology (ONC) is the principal federal entity responsible for the coordination of adoption and implementation of electronic health information technology. The significant events and milestones related to EMR/EHR adoption in the country are listed below:

1. The 1960s-1970s: Evans (2016, 48), stated that early computerized health records systems, such as the Medicomputer and the Problem-Oriented Medical Information System (PROMIS), were developed and implemented in a few hospitals and academic medical centers solely for data analysis and research and not for clinical care.
2. The 1980s: The first large-scale integrated EHR system called the Decentralized Hospital Computer Program (DHCP) was implemented by the Veterans Health Administration (VA). A comprehensive EMR was provided for VA hospitals and clinics across the United States by DHCP.[37].
3. 1991: A report that highlighted the potential benefits of electronic patient records, improved patient safety, and quality of care was published by the Institute of Medicine in 1991 and titled "The Computer-Based Patient Record: An Essential Technology for Health Care." [38].
4. 2004: A goal was set by President George W. Bush for most Americans to have access to EHRs within 10 years. This was part of his State of the Union address.[39].
5. 2009: As part of the American Recovery and Reinvestment Act (ARRA), the Health Information Technology for Economic and Clinical Health (HITECH) Act was passed to provide financial incentives to healthcare providers to adopt and meaningfully use certified EHR systems.[40].
6. 2010: The Meaningful Use Program was announced and the criteria for eligible healthcare providers to qualify for EHR incentive payments was established by the Office of the National Coordinator for Health Information Technology (ONC) and the Centers for Medicare and Medicaid Services (CMS).[41].
7. 2014: New requirements for EHR use and interoperability were introduced as the Meaningful Use program transitioned to the Medicare Access and CHIP (The Children's Health Insurance Program) Reauthorization Act (MACRA) and the Merit-based Incentive Payment System (MIPS) in 2014.[42].
8. 2015: The Interoperability Roadmap was released by the ONC which outlined the framework for achieving nationwide interoperability of health information through EHR use.[43].
9. 2016: The 21st Century Cures Act was passed. It requires healthcare providers to issue electronic copies of patients' records in machine-readable form to patients who request it.
10. 2020: In response to the COVID-19 pandemic, the Coronavirus Aid Relief, and Economic Security (CARES) Act was passed to promote and expand the use of telehealth, remote patient monitoring, and the use of EHRs in delivering healthcare services during the pandemic.[44].
11. 2021: The final rule for the 21st Century Cures Act was released by the ONC to improve interoperability and access to EHR Use.[45].

This timeline is not exhaustive as there have been numerous developments, regulations, and advancements in the history of EMR/EHR use in the United States. Ninety-six percent of non-federal acute care hospitals and 86% of office-based physicians had adopted a certified EHR system as of 2017.[24].

The Overview of the Ethiopian Health System

Ethiopia is the second most populous country in Africa with a population of 116, 462,712 diverse ethnic groups covering 1,104,300 sq km and a real GDP per capita of $2,300. According to Yitbarek et al (2023, 474), the country's healthcare runs a three-tier system which includes care at the primary, secondary, and tertiary levels. Notwithstanding this, non-communicable diseases account for 49% of DALYs and 41% of lives lost due to premature death in years. However, these deaths and the prevalence of these diseases can be prevented with a well-structured healthcare system and health information systems such as EHRs.[24].

History, Adoption, and Status of EMRs/EHRs In Ethiopia

The adoption and implementation of EMRs/EHRs in Ethiopia have been relatively recent and are gaining traction as the country seeks to modernize its healthcare system to improve patient care. The timeline of events in the use of EMR/EER is highlighted below:
1. 2007: The use of EHRs began in the mid-2000s in Ethiopia with pilot projects initiated by non-governmental organizations (NGOs) and international partners. The feasibility of implementing EMRs/EHRs in the Ethiopian healthcare system and evaluation of their impact on patient care was tested with these pilot projects One notable project was the implementation of an EMR system in the Black Lion Hospital in Addis Ababa in partnership with the University of California San Francisco (UCSF) and the Ethiopian Ministry of Health (MOH) in 2007. This project was funded by the President's Emergency Plan for AIDS Relief (PEPFAR) [46, 47].
2. 2009: The Integrated eHealth Information Management System (ieHIMS) by the Ethiopian Ministry of Health in collaboration with the Clinton Health Access Initiative (CHAI) was initiated in 2009 to digitize health information across the country [48].
3. 2015: The Ethiopian Health Sector Transformation Plan (HSTP) was launched by the Ethiopian Ministry of Health, and focused on digital health, the aim is to achieve universal health coverage using EMRs/EHRs and other health information technologies (HSTP – II, 2021).

4. 2019: The Ethiopian eHealth Strategy by the Ethiopian Ministry of Health was introduced, which outlines the strategic direction for the use of digital health technologies, including EMRs/EHRs, in the country [49, 6]. In Ethiopia, the adoption and implementation of EMRs/EHRs are still in their early stages and have been relatively slow and fragmented, with implementation mainly limited to pilot projects and a few healthcare facilities. However, the recognition of the need for modernization of the healthcare system and the potential benefits of EMRs/EHRs in improving patient care and health outcomes has been on the increase.

Kenya's Health System

Kenya is an LMIC located in sub-Saharan Africa with a total population of 57,052,004 as of 2023 covering a total geographical area of 580,367 sq km with a real GDP per capita of $4,700 USD, and the third-largest fast-growing economy in sub-Saharan Africa [50]. Healthcare is considered a fundamental human right in Kenya which is seen in its constitution. This is implemented through the primary healthcare system in the 47 county governments. However, the national government is responsible for the coordination, implementation, and management of health programs [51].

History, Adoption, and Status of EMRs/EHRs In Kenya

EMRs/EHRs adoption and use in Kenya can be traced back to the early 2000s when the country started exploring how to improve healthcare services with the use of information technology. This resulted in the implementation of several pilot projects and programs by the Ministry of Health in collaboration with various stakeholders. The timeline of the events is discussed below:

1. 2004 – 2007: [52,7], revealed that the first EMR pilot project was initiated in selected healthcare facilities in Nairobi, Kenya by the Ministry of Health in partnership with the University of Nairobi and other stakeholders. The aim was to assess how feasible and effective the implementation of EMRs can improve the management of patient care.
2. 2008 – 2012: The EMR pilot project was extended to healthcare facilities in other regions such as Kisumu, Eldoret, and Mombasa. International partners supported the project to develop standardized EHRs, improve data management, and train healthcare providers on the effective use of EMR/EHR [52].
3. 2013 – 2017: Significant progress was made in the adoption of EMRs/EHRs in Kenya as the Ministry of Health rolled out different EMR/EHR systems across the country. An example is the implementation of the District Health Information System (DHIS2), an open-source health management information system with EHR functionalities. The national health information system incorporated DHIS2 to increase data collection, management, and reporting. Other electronic health management systems deployed included the International Quality Care (IQCare) for clinical management of HIV or AIDS between 2012 and 2013, and the Afya Electronic Health Management System (AfyaEHMS) deployed in 2004 to accommodate more comprehensive management of patients through the counties [53.]
4. 2018-Present: According to [52], EMR/EHRs adoption in Kenya is growing with public and private healthcare organizations adopting different EMR/EHR systems. Also, various organizations, such as non-governmental organizations, and private companies have partnered with the government to support the use and implementation of EMRs/EHRs in Kenya.

The Malawian Health System

While progress has been made, challenges to the widespread adoption of EMRs/EHRs such as inadequate funding, limited infrastructure, and limited capacity of healthcare organizations to use EMRs/EHRs effectively still exist, and the government and other stakeholders are working on bringing these challenges under control [52].

Malawi is a low-income country with a total population of 21,279,597 as of 2023, with diverse ethnic groups covering a total geographical area of 118,484 sq km and real GDP per capita of $1500 USD [50]. It was ranked 171st out of 189 countries during the Human Index Development of 2017 as 71.4% of the population lives below the poverty line and nearly 80% live in rural areas because subsistence farming is common [54.] Consequently, the country faces a high degree of morbidity and mortality because of malnutrition and infectious diseases such as tuberculosis, HIV/AIDS, stroke, and diarrhea. Also, chronic diseases such as asthma, hypertension, cancer, and diabetes are on the rise [54.]. The provision of healthcare services is organized in a three-tier level system namely the primary, secondary, and the tertiary level. The government owns 60% of the health facilities, and 36% is owned by the Christian Health Association (CHAM) in contract with the Ministry of Health through the Service Level Agreements (SLAs) while 4% is owned by the private for-profit providers [54.]

History, Adoption, and Status of EMRs/EHRs In Malawi

The adoption of EMRs/EHRs in Malawi is still limited and in its early stages. Most healthcare organizations still rely on paper-based record-keeping systems. However here are the significant events in their EMR history:

1. 2012: The Electronic Health Information Management System (eHMIS) was initiated by the Ministry of Health (MoH) in Malawi in 2012 to enhance the collection, storage, and management of healthcare data [55,] 241)
2. 2013: According to the Malawi National Health Information System Policy (2015), [56], the District Health Information Software 2 (DHIS2), an open-source health management information system (HMIS) was launched by the MoH to manage health data at district and national levels. However, DHIS2 is not a comprehensive EMR/EHR system, it is used for reporting and analysis of health data.
3. 2017: A pilot project for an EMR system called "SmartCare" was conducted in three health facilities in Lilongwe Malawi. SmartCare is an open-source EMR system developed by Baobab Health Trust, a Malawian non-governmental organization (NGO), with support from various partners including the U.S. Centers for Disease Control and Prevention (CDC) and the Elizabeth Glaser Pediatric AIDS Foundation (EGPAF) [57.]

The Malawian government and various stakeholders are promoting the adoption of EMRs/EHRs to improve patient care, public health outcomes, and health data management despite several challenges such as unreliable electricity supply, limited infrastructure, inadequately trained personnel, and limited financial [58], 250).

The Nigerian Health System 2.1.20 History, Adoption, and Status of EMRs/EHRs In Nigeria

Nigeria is the most populous country in Africa with a population of 230,842,743 as of May 03, 2023, and covers 923,768 sq km with diverse ethnic groups. It is comprised of 36 states and a federal capital territory, Abuja. The real GDP per capita is $4,900 (USD) as of 2021 [50.] Despite its economic status, health coverage is uneven and has the highest mortality rate in the world. Maternal and infant mortality rates are 545 per 100,000 and 87 per 1,000 live births, accounting for 10% of global child deaths. Life expectancy at birth is 49 years while disability-adjusted life years are 38.3. For every 100,000 women, 840 die accounting for 14% of global maternal deaths while the under-five mortality rate is 128 per 1,000 live births [59]. In general, the country faces a severely erratic power supply and 35% of the installed power supply is not functional, notwithstanding the high rates of electrification [60.] Although it is not known if these deaths are due to medical errors, however, successful adoption and implementation of HER in the Nigerian health systems can improve the quality of health care delivery rendered to patients.

[61,62] 15) revealed in their study that the adoption EMRs/EHRs in Nigeria has been relatively slow, especially in the public healthcare sector. However, the implementation of EMRs/EHRs can be traced back to the mid-2000s when few private healthcare organizations started using EMRs/EHRs in the management of patient data. The key events in the Nigerian EMR/EHR use are stated below:
1. 2006 – 2009: Reddington Hospital in Lagos was one of the first healthcare organizations to adopt and implement an electronic system in 2006 to manage patients' records and improve care followed by Cedarcrest Hospitals in 2007, and the Nordica Fertility Centre in 2009 [63].
2. 2010: According to [64], the National Health Management Information System was launched by the Nigerian government in 2010 to improve the collection, management, and use of health information, consequently promoting the adoption of EMRs/EHRs in healthcare facilities across the country.
3. 2012: The Open Smart Register (OpenSRP) was launched by the World Health Organization (WHO) in Nigeria to encourage the collection and management of health data at the primary healthcare level [65, 63,64).]
4. 2017: [64], 286) showed the Nigeria Health Facility Registry (NHFR) includes a comprehensive database of all health facilities in the country, and their digital capabilities were launched by the Federal Ministry of Health in 2017. However, the country faces challenges such as inadequate infrastructure, limited funding, and inadequate awareness and training on the use of electronic systems [65.]

Overview of Bangladesh Health System

Bangladesh is one of the most densely populated and poorest low-income countries with a total population of 167,184,465 as of 2023 covering a total geographical area of 148,460 sq km with a real GDP per capita of $5,900 USD [50.] The provision of health services in Bangladesh is pluralistic with non-governmental health services providers such as for-profit and non-profit organizations, and traditional and non-formal practitioners predominating governmental health services [66]. However, the control of the government of Bangladesh's health services is centralized in the Ministry of Health and Family Welfare MOHFW

History, Adoption, and Status of EMRs/EHRs In Bangladesh

Electronic Health Records (EHR) and Electronic Medical Records (EMR) are still in the early stages of adoption in Bangladesh. However, there have been efforts to introduce these systems in the country over the years as highlighted below:
1. 1998: The e-Health initiative started in 1998 with the Ministry of Health and Family Welfare (MOHFW) managing the Health and Population Sector programs to improve their efficiency.
2. 2009: Health services through mobile phones called "mHealth" was established by the Ministry of Health in all districts and Upazila hospitals.

3. 2011: A pilot project was initiated by the Bangladesh Ministry of Health and Family Welfare to implement an EMR system in selected government hospitals in Dhaka. The project aimed to digitize patient records, improve data accuracy, and enhance communication between healthcare providers.
4. 2015: the government launched the "Digital Bangladesh" initiative, which included plans to implement EHR systems across the country. The initiative aimed to improve the quality of healthcare services, reduce healthcare costs, and improve patient outcomes.
5. 2016: A memorandum of understanding was signed between the Bangladesh government and South Korea to develop an EHR system for the country. The project aimed to develop a comprehensive EHR system that would integrate all health-related data across the country's health system.
6. 2019: A National Health Information System called the "Bangladesh Health Information Exchange (BdHIE)". was launched by the Bangladesh government. The platform aimed to enable the exchange of health information between different healthcare providers and improve the coordination of care.

Notwithstanding these efforts, the adoption of EHR/EMR systems in Bangladesh has been slow due to various challenges, including limited infrastructure, inadequate training of healthcare professionals, and a lack of standardized protocols for data exchange.

In conclusion, while Bangladesh has made efforts to implement EHR/EMR systems in recent years, these systems are still in the early stages of adoption in the country. However, the government's initiatives and collaborations with other countries suggest that there is potential for the widespread adoption of these systems in the future ([67,68] Online Population Health Registry Bangladesh).

Overview of Ghana's Health System

According to [50], Ghana has a total population of 33,846,114 as of 2023 covering a total geographical area of 238,533 sq km with real GDP per capita of $5,400. The country is the first to introduce nationwide health insurance in Africa to attain universal health coverage (UHC) and the introduction and reform of the national health insurance scheme (NHIS) in 2003 and 2012 is one of the major characteristics of the Ghanaian healthcare system. Forty percent of the population are enrolled and are exempt from premium payments, and this allows for better access to health care, although the system's financial sustainability is being questioned [69].

History, Adoption, and Status of EMRs/EHRs In Ghana

Electronic medical record (EMR) use in Ghana has been growing steadily over the years, although there are still challenges to be addressed. Here is a timeline of key events related to EMR use in Ghana:
1. 2008: The Ministry of Health (MoH) launches the eHealth Strategy for Ghana, which outlines the goals and objectives for the country's health IT infrastructure.
2. 2009: The MoH establishes the Ghana Health Service (GHS) as the main provider of healthcare services in the country.
3. 2010: The GHS launches the District Health Information Management System (DHIMS) to digitize health records and improve data management at the district level.
4. 2012: The MoH partners with the US Centers for Disease Control and Prevention (CDC) to implement an EMR system in selected health facilities across the country.
5. 2015: The MoH launches the National Health Insurance Scheme (NHIS) e-claims platform, which allows healthcare providers to submit claims electronically.
6. 2017: The MoH and the GHS launch the e-Tracker system, a mobile app that allows community health workers to collect and report health data in real-time.
7. 2018: NHIS mobile renewal service implemented for payment of health insurance coverage using mobile money technologies.
8. 2021: The COVID-19 pandemic accelerates the adoption of telemedicine and other digital health solutions, including the use of mobile apps for remote patient monitoring and consultation ([70], 230, [71], [72,73,74], n.d., [69])

Benefits of EMRs/EHRs

The exchange of health information electronically with EMRs/EHRs provides more quality and safer care for patients, consequently helping healthcare providers to provide better care and better health. The benefits of using EMRs/EHRs in healthcare delivery are enormous as established by many scholars. A few of them such as [75,76,77] outlined these benefits to include:
1. Provision of accurate, up-to-date, and complete information about patients during clinical visits.
2. Allows real-time access to clinical data, patient information, or record leading to more accurate diagnosis, and better treatment decisions, while providing more coordinated, and efficient care, consequently improving daily management of workflows and patient outcomes.
3. Allows secure sharing of electronic health information between patients and other clinicians leading to better continuity of care.

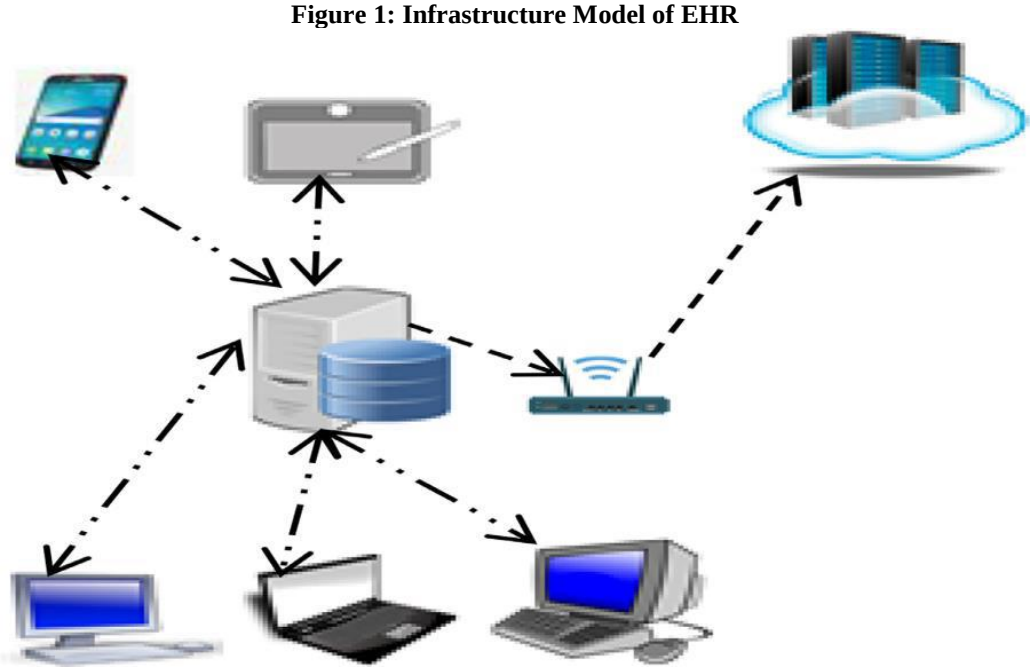
4. Enhances effective diagnosis of patients, reduction of medical error, and provision of safer care by healthcare providers.
5. Improves interaction and communication between patients and healthcare providers allowing for healthcare convenience.
6. Enables safer and more reliable prescribing and enhances drug therapy monitoring.
7. Promotes accurate, legible, and complete documentation, billing, and streamlined coding.
8. Maintains privacy and security of patient data.
9. Improves productivity and the work-life balance of healthcare providers.
10. Improves the efficiency and business goals of healthcare providers.
11. Increases patient engagement by allowing patients access to their own health information, communicating with their healthcare providers, and participating more actively in their own care.
12. Reduces cost through paperwork reduction, improved safety, reduction of waste, decreased duplication of testing, and improved health.
13. Clinical decision-making is improved through the integration of patient information from different sources.
14. Population health is also improved through education on healthy lifestyles, the practice of preventive care such as better nutrition, avoidance of behavioral risks, and increased physical activity.

Structure of EMR/EHR

Overall, better healthcare of patients is improved in all aspects such as safety, patient-centered care, communication, education, timeliness, efficiency, and equity.

The structure and the content of EHR have varied over time ranging from time-oriented, problem-oriented, and source-oriented EHRs. These days all three elements are combined in EHRs. Time-oriented EHRs involves the presentation of data in chronological order, while problem-oriented medical record (POMR) notes each problem assigned to patients and describes it following the subjective information, objective information, assessments, and plan (SOAP). On the other hand, the source-oriented arranges the content of the record according to the method of information obtained [78]. To ensure interoperability of EHR systems in both high and LMICs the architectural infrastructure should be built on client-server models for laptops, desktops, and mobile-based applications and a mix of web-based applications that works on mobile devices like tablets and smartphones, see Figure 1.

Figure 1: Infrastructure Model of EHR



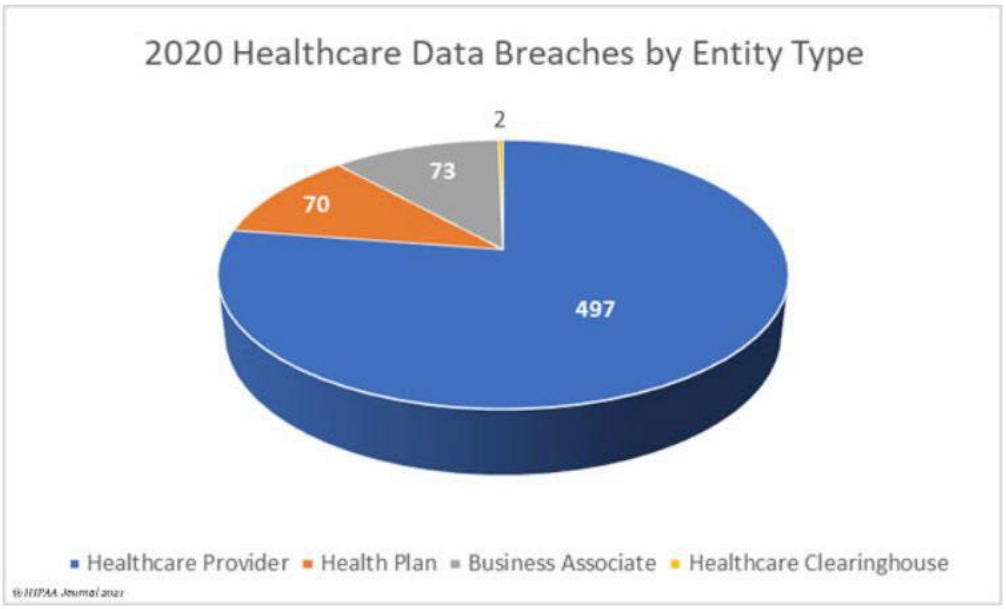
Source: Adetoyi and Raji, (2020).

Review of Related Literature

To achieve the United Nations Sustainable Goal of providing good health and ensuring well-being for people of all ages, the integration of EHRs in the national healthcare systems of high and low-income countries is vital. [79], and [80] investigated EMRs and EHRs stating that EMRs/EHRs in healthcare have been proven to facilitate work processes and their benefits cannot be overemphasized. Also, its adoption has grown significantly over the

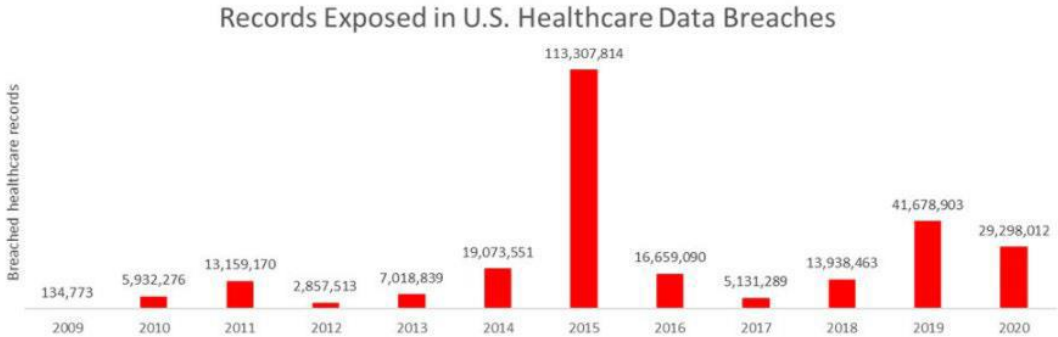
years. However, they established that challenges and barriers are still recorded in both high and low-income countries. According to [81], and [7], countries like the United Kingdom, the United States, and Australia have growing and robust healthcare infrastructures that receive funding and support from their government thus making the application and sustainability of EHR/EMR easy and seamless. However, high-income countries face challenges and barriers such as costly software packages, system security, patient privacy, security, and confidentiality, interoperability, access control, availability, accessibility, data storage, data ownership, data validity, data intensity, ease of use, and unknown future government regulations [12]. For example, HHS (2022) while analyzing the prospects of EHR/EMR identified four major entities with the most data breaches in 2020 as shown in Figure 1. Healthcare data breaches have increased significantly in the US. In 2020, the healthcare industry had the largest number record of data breaches since 2009 (Figure 2). This, therefore, calls for more concerted efforts amongst stakeholders on how to effectively utilize EMR and EHR (HIPAA, 2020).

Figure 2: Healthcare Data Breaches by Type (HIPAA, 2020).



Source: HIPAA, (2020).

Figure 3: Healthcare Data Breaches from 2009 – 2020 (HIPAA, 2020)



Source: HIPAA, (2020).

On the other hand, the growth rate of adoption and use of EMRs/EHRs in LMICs is said to be comparatively low, slow, and still in its early stages. Some of their use is more administrative than clinical as revealed by [79], [7], [82]. [83], further showed that 91% of countries in LMICs especially sub-Saharan Africa use open-source health software, and open MRS is mostly used in HIV-related centers, although the penetration is still very low. This is due to factors such as costs, security concerns, lack of education and training, power blackouts, poor infrastructure, unreliable internet connectivity, limited computer skills, and training, inadequate technical support, poor strategies, and human capacity [85,84, 75].

[86] 202) noted that the implementation of software, hardware, and IT networks is important for a successful electronic health record project. [52], further recommend open-source software for LMICs to ensure ongoing developments and implementation of EHRs across Africa because it provides opportunities for local use

adaptation, involves end-user buy-in, and rolling out in both smaller and larger hospitals. In addition, [80] stated that traditional software testing should be augmented with process mining where workflow is analyzed with event logs from EHRs and potential system weaknesses are identified and customizations are made prior to the go-live phase through visualization of results, thereby minimizing or preventing challenges. Overall, [75], [12], and [87], 230) showed that proper education, training, and implementation strategies are required for healthcare workers to effectively work with new systems and prevent cyber-attacks. Future technologies for electronic health records include bar coding, radio-frequency identification, and speech recognition.

Conceptual Framework: Kurt Lewin's Change Model

Lewin's organizational change model is a widely used framework created in 1947 by a German – American psychologist called Kurt Lewin. The model is used for managing and implementing change in organizations. It consists of three stages: unfreezing, change, and refreezing. These stages are intended to create a structured approach to change management that helps organizations transition from the old way of doing things to the new ([88],35). [89], 123) and the Mind Tool Content Team (n.d) highlights the content of each stage as follows:

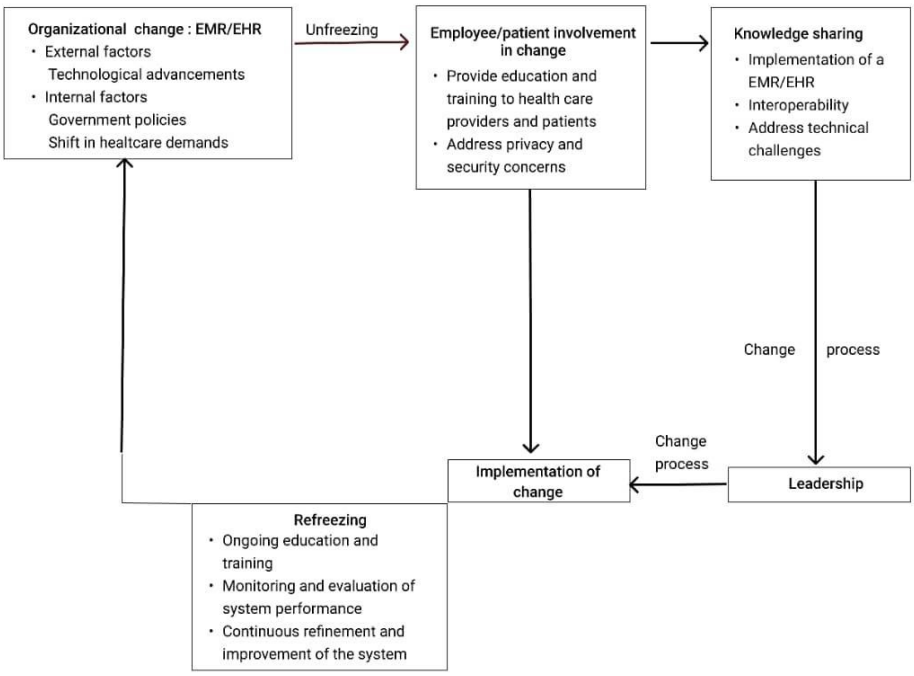
Unfreezing Stage: This stage involves creating awareness and motivation for change. It is the initial stage of the change process that involves identifying the need for change, creating a sense of urgency, and communicating the vision for the change. In this stage, stakeholders need to be convinced that the current way of doing things is no longer sustainable, and change is necessary. This is the stage where resistance to change is identified and addressed through communication, education, and support.

2. Change Stage: This stage is where the actual change occurs. It involves developing and implementing new practices, processes, and systems that will achieve the desired outcomes. This is the stage where the organization implements the new technology, system, or process that will improve its operations. It requires careful planning, communication, and management to ensure that the change is successful. Resistance to change is still possible at this stage, and it must be addressed with ongoing support and training.

3. Refreezing Stage: This stage is the final stage of the change process. It involves embedding the new practices, processes, and systems into the organization's culture and making them a part of the daily operations. It is the stage where the organization stabilizes and consolidates the change to ensure it becomes a permanent part of its operations. The new practices, processes, and systems are reinforced through training, monitoring, and performance management.

Lewin's change model provides a structured approach to change management that can be applied to various change initiatives, including the adoption of electronic medical records/electronic health records. By following this model, organizations can better manage the complexities of change and ensure that the change is successful and sustainable.

Figure 4: Conceptual model, adapted from Kurt Lewin's Model (1947).



Source: Kurt's Lewin's Model (1947), adapted by the Researcher

Application to Study

This study was guided by the organizational change theory developed by Kurt Lewin. The theory is concerned with how organizations respond to external and internal forces, such as technological advancements, changes in government policies, and shifts in healthcare demands.

In this case, the adoption of EMRs/EHRs is a change initiative aimed at improving the quality of care, reducing medical errors, and increasing efficiency in healthcare delivery. The adoption of EMRs/EHRs requires a significant shift in the way healthcare providers operate and communicate with each other and their patients. Organizational change theory can provide a framework for understanding the complexities of the adoption process and the factors that influence its success.

Kurt Lewin's change model can be applied to this study to understand the stages of change and the strategies that can be employed to facilitate the successful adoption of EMRs/EHRs. Lewin's change model consists of three stages: unfreezing, change, and refreezing.

1. The unfreezing stage involves preparing individuals and organizations for change by creating awareness of the need for change and reducing resistance to it. In the context of this study, this stage involves planning, providing education and training to healthcare providers and patients on the benefits of EMRs/EHRs, addressing the need for a change, concerns about privacy and security, and creating a shared vision of the desired future state.
2. The change stage involves implementing new practices and systems. In this study, this stage involves developing and implementing strategies to integrate EMRs/EHRs into existing healthcare systems, ensuring interoperability between different systems, and addressing any technical challenges that may arise.
3. The refreezing stage involves embedding the new practices and systems into the organization's culture and processes to ensure long-term sustainability. In the context of this study, this stage may involve ongoing education and training to ensure that healthcare providers and patients are using EMRs/EHRs effectively, monitoring and evaluating the system's performance, and continuously refining and improving the system to meet changing needs.

Therefore, applying organizational change theory to this study provides a framework for understanding the complexities of the adoption process and the factors that influence its success.

By using Kurt Lewin's change model, the study can identify the strategies that can be employed to facilitate the successful adoption of EMRs/EHRs in low and high-income countries.

III. Materials and Methods

Introduction

This chapter discusses the methods and techniques used to address the research questions of developing strategies for implementing EMRs/EHRs in high and LMICs through a comparative analysis. The overview of the research design, research setting, selection criteria, method of data analysis, ethical considerations, and areas for further study are discussed. Based on the research goals and questions, the six high-income countries selected for the study studied were Australia, Canada, Germany, Israel, the United Kingdom, and the United States while the six low-middle-income countries selected were Ethiopia, Kenya, Malawi, Bangladesh, Ghana, and Nigeria.

Research Design

The research design used in this study was a systematic review of existing literature which falls under the umbrella of the qualitative research method because it involves the collection, analysis of content, themes, and interpretation of non-numerical data such as peer-reviewed articles, books, and other written materials to discover meanings, patterns, and relationships. Although the literature review methodology is qualitative, the sources reviewed include both qualitative, quantitative, and mixed studies depending on the research topic, objectives, and questions. A comparative critical analysis of the strategies for adopting and implementing EMR/EHR in high and low-middle-income countries was done through a comprehensive systematic review of existing works of literature from selected countries. Three main stages were used in this study: planning and design, literature search and review, and data analysis and synthesis.

Planning and Design

This stage involved defining the research question and objectives, selecting the countries to be included in the study, and developing inclusion and exclusion criteria for the literature search based on the research question and objectives to ensure s focused and relevant literature search. Six countries from low-middle-income countries and six countries from high-income countries were conveniently selected due to the availability of studies on EMR/EHR strategies for adoption, implementation, and challenges. Other factors considered for the countries selected include:

1. Feasibility: to conduct a comparative analysis, a significant research effort such as a literature review and analysis requires the selection of a manageable number of countries to allow for an in-depth examination of resources available within a scope.

2. Representativeness: the selected countries represent their respective income groups according to the World Bank Country Classification and diverse healthcare systems including cultural contexts, and regional variations are represented to provide a wide comparative analysis of experiences in EMR/EHR implementation. For example, Australia has a well-developed healthcare system and has achieved substantial progress in the implementation of EMR/EHR. Canada serves as an example of a high-income country with a diverse healthcare landscape (provinces) in both rural and urban settings and had made significant investments in the implementation of EHR. Therefore, insights can be drawn from its adoption strategies. Also, Germany has made a significant achievement in digital health and is known for its strong healthcare system. Israel on the other hand represents a smaller high-income country that has achieved nationwide implementation of EHR systems and has been at the forefront of innovations in digital health while the UK represents a well-established healthcare system that has achieved large-scale HER implementation in a centralized healthcare system. In addition, the US has a complex healthcare system with different regulations and models of healthcare delivery and has recorded successes and challenges in EHR implementation. For LMICs, Nigeria is the most populous country in Africa with a diverse healthcare infrastructure. Ethiopia represents one of the fastest-growing economies in Africa and has been investing in the improvement of healthcare services, Malawi is a low-income country in sub-Saharan Africa making efforts to improve its healthcare system, Bangladesh is an LMIC with a significant population but limited resources, Kenya has been an example in digital health innovations in Africa to advance its healthcare system while Ghana has made progress in EMR/EHR implementation in its healthcare system. Overall, insights are drawn from these countries to develop strategies for EMR/EHR adoption and implementation applicable to each country group.
3. Comparative Analysis: selected six high-income and six LMICs to allow for a balanced comparison between the two groups and the identification of common trends, differences, and lessons learned across different socioeconomic contexts.
4. Manageable Scope: To avoid dilution of the data analysis through an overly broad and complex study, a total of 12 countries were selected. Conversely, a lower number of countries are likely not to provide adequate diversity and comprehensiveness in the study.

Literature Search and Review

Denver University academic database called the "Compass" was used in conducting literature searches. This database is exhaustive and includes various databases such as Google Scholar, PubMed Central, EBSCOhost Academic Search Complete, ProQuest Central, Scopus, Elsevier ScienceDirect Journals, Healthcare Administration database, and Computer Science Database. The search terms and keywords included EMRs/EHRs, strategies for adoption and implementation, high-income countries, low-middle-income countries, and selected countries of interest. The identified studies were reviewed for their relevance to the research question and objectives.

Selection Criteria

The steps used to identify and select relevant studies for the research question are highlighted below:
1. Database Search: A comprehensive search of electronic databases was conducted using a combination of keywords such as electronic medical records, electronic health records, strategies for adoption and implementation, HICs, LMICs, and selected countries of interest.

Inclusion Criteria:

1. Studies published in the English language from 2010 to 2023.
2. Studies focused on adopting and implementing EMRs/EHRs in high-income and LMICs.
3. Studies that revealed the challenges and strategies for implementing EMRs/EHRs
4. Studies with quantitative, qualitative, or mixed methods research design.

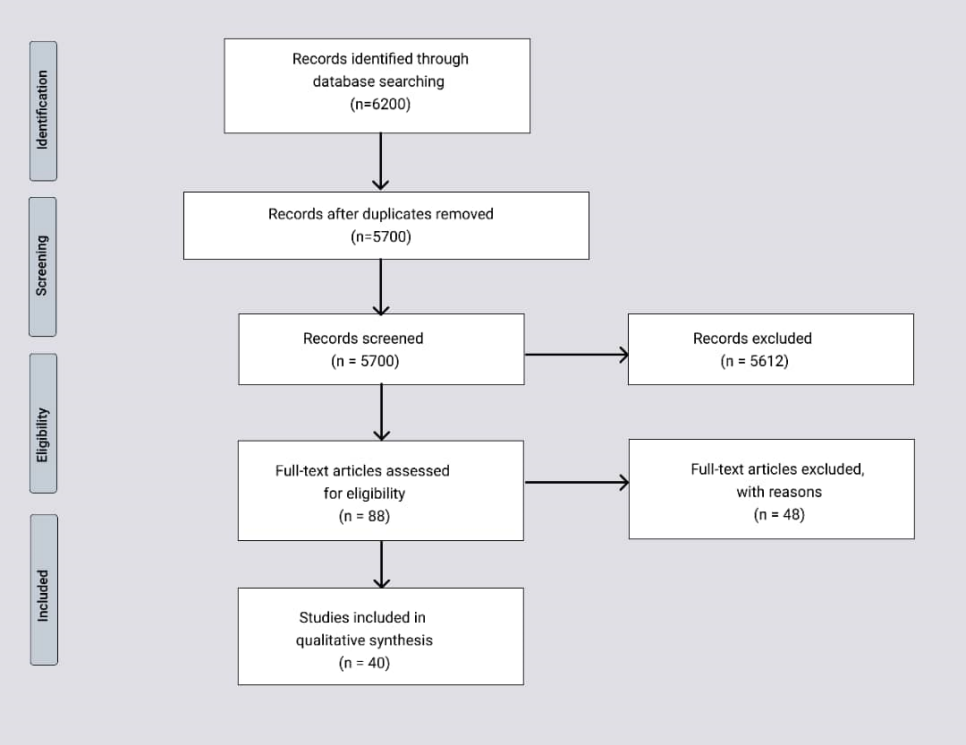
Exclusion Criteria:

1. Studies that did not focus on EMRs/EHRs, their adoption, and implementation, nor the challenges and strategies related to their implementation.
2. Studies published before 2010 or after 2023.
3. Non-peer-reviewed studies and articles such as commentaries, editorials, or letters.
4. Studies focused on particular diseases or medical conditions such as pediatrics, or geriatric populations rather than the general focus on implementing EMRs/EHRs in different countries.
2. Screening: the titles and abstracts of retrieved studies were screened by two independent reviewers to determine their relevance to the research question, therefore, studies that did not meet the inclusion and exclusion criteria were removed at this stage.

3. Full-text review: the full text of selected studies was reviewed by two independent reviewers to determine their eligibility for inclusion.
4. Extraction of Data: data was extracted from selected studies which included the author(s), year of publication, study design, country, implementation strategies, and outcomes.
5. Synthesis: Data extracted from selected studies were analyzed by themes.

Overall, a total of 40 peer-reviewed articles were used to answer the research questions, The search process was documented with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) tool as shown in Figure 5.

Figure 5: The PRISMA Flow Diagram for Study Selection



Source: Researcher's study selection, 2023

Data Analysis and Synthesis

A thematic analysis approach was used to synthesize the findings from selected studies. According to ([90], 846), this method of qualitative data analysis involves the identification of patterns and themes in data through a systematic review and coding of data. The steps used to analyze the identified data are described below.
1. Familiarization of Data: the selected studies were read and re-read to become acquainted with the content and relevant data related to the study was identified.
2. Coding: relevant data identified from selected studies were coded according to key contents related to the research questions and objectives.
3. Generation of themes: Coded studies were organized into themes, according to their similarities and differences.
4. Data Interpretation: themes generated were interpreted and supported with evidence from selected studies.
5. Synthesis: synthesis of findings identified common themes and patterns and the differences between the groups of countries studied.

To ensure the validity and reliability of the findings, two independent reviewers carried out the data analysis process. Discrepancies between the reviewers were resolved through discussion and consensus.

Research Setting

This study was based on a literature review; therefore, the research setting is not a physical location, but rather a virtual one. Online platforms such as Google Drive, Microsoft Word, and Excel were used to store and analyze data collected from electronic databases during the literature search. These databases can be accessed from any location where an internet connection exists, and this allows researchers to have access to a wide range of studies from various regions of the world. Also, online platforms allow for sharing of data among researchers irrespective of their physical location.

Overall, the virtual space where electronic databases and the online platforms used in this study are located comprised the research setting.

Ethical Considerations

Respect for intellectual property was maintained through proper citation and referencing, and peer-reviewed works of literature were used in answering the research questions to minimize biases and misinterpretation of data.

IV. Data Analysis, Results, And Discussion Of Findings

Introduction

The potential to improve patient care and health outcomes around the world has led to the adoption and implementation of technologies such as EMRs/EHRs in the healthcare sector. However, adopting and implementing these technologies can be challenging, especially in low-middle-income countries due to limited resources and infrastructure. This study was designed to compare challenges and develop strategies for adopting and implementing EMRs/EHRs in LMICs and HICs. The following research questions were answered and discussed in the study:

1. What are the key challenges faced by LMICs in implementing EMR/EHR systems, and how do they differ from those faced by HICs?
2. What are the current EMR/EHR implementation strategies in LMICs and how do these strategies differ from those used in HICs?
3. How do social and cultural factors affect EMR/EHR adoption in LMICs and HICs?
4. What are the potential benefits and risks of EMR/EHR adoption in LMICs and HICs?

A systematic literature review was conducted to answer the research questions and a thematic method of data analysis was used. The study focused on six low-middle-income countries namely (Bangladesh, Ethiopia, Kenya, Malawi, Nigeria, and Sierra Leone) and six high-income countries (Australia, Canada, Germany, Israel, United Kingdom, and the United States). A total of 40 articles were selected based on their relevance and quality. Results are presented in tables and discussed in sections.

Data Analysis and Results

Research questions

Research question 1: What are the key challenges faced by low-income countries in implementing EMR/EHR systems, and how do they differ from those faced by high-income countries?

For this study, the challenges to the adoption and implementation of EMRs/EHRs in both high and LMIC are classified into five categories: organizational factors, individual factors, financial factors, ethical-legal factors (management factors inclusive), and technical factors as shown in Table 1. This classification was supported by a study done by ([18], 144).

Table 1: Classification of Challenges to Adopting and Implementing EMRs/EHRs in High and LMICs.

Themes/Challenges	Indicators
Individual factor	• Unfamiliarity • User resistance due to limited awareness • Mistrust and fear • Inadequate time to use the computer. • Increase workload. • Inadequate knowledge and competency • Resistance to change and • Increase stressors.
Organizational factor (Management Barriers)	• Inadequate skilled manpower and insufficient senior management • Limited training courses • Lack of strategic plans for the implementation of new systems • No mutual relationship and interaction among team members
Financial challenges	• Inadequate funds for hiring more staff. • Lack of budget planning • Lack of incentives
Ethical-legal challenges	• Unauthorized access to patient information • Lack of computer system security and privacy

	• Lack of policy for EHR
Technical challenges	• Lack of efficient health information systems • Inaccuracy of guidelines • Lack of accepted software • Lack of a national standard terminology for EHR systems and • Service complexity

Table 2: Challenges Faced by LMICs In Adopting and Implementing EMRs/EHRs

Country	Study, Year	Type Of Study	Challenges	Themes/Category
Ethiopia	[6]	Mixed Methods (Quantitative: institutional cross-sectional explanatory study, Qualitative: thematic analysis	Poor health information system. Electric power interruption, Health professionals' technology resistance, Infrastructure, and administrative problems.	Organizational, Technological, Individual, and Ethical legal factors.
	[4]	Quantitative (Institutional based cross-sectional study)	Knowledge, attitude, awareness, innovation, training, computer literacy, workload, management support, work experience, perceived benefit, computer use, and internet access.	Organizational, Technological, Individual, and Ethical legal factors
	[91]	Qualitative (A systematic literature review)	Absence of EMR training, limited access to computers, insufficient computer literacy, deficient EMR knowledge, inadequate technical help, absence of EMT manual, negative attitude to EMR, limited internet access, lack of management support, interruption of electric power, absence of perceived system quality, absence of perceived information quality, lack of willingness, the complexity of the system, performance expectancy, effort expectancy, and lack of IT qualification	Financial, Organizational, Technological, Individual, and Ethical legal factors
Bangladesh	[92]	Quantitative (Cross-sectional survey)	Social Influence (perceived need to use a new system), Facilitating Conditions (technical and organizational infrastructure), and Personal Innovations (the degree to which an individual is exposed to using new systems).	Organizational, Individual, and technical factors.
	[84]	Mixed methods (interviews and observational study (case-control)	Costs, inadequate infrastructure, scarcity of human resources, lack of information and communication technologies (ICT) skills, poor strategies and donor policies, and subtle issues such as power dynamics and identity formation, politics, everyday-routine integration, social factors, and resistance to new technology.	Financial, Organizational, Technological, Individual, and Ethical legal factors
	[67]	Qualitative (thematic analysis)	Inadequate ICT infrastructure, financial problems, resistance to change, usability and user acceptance, lack of policy and regulations, and interoperability of systems	Financial, Technological, Individual, and Ethical legal factors
Kenya	[7]	Qualitative (two focus group discussions)	System functions (lack of updates on system upgrades and delayed upgrades), Training (lack of regular training, selective user training, and lack of IT training content), and technical support (delayed IT support). Human factors include high staff turnover, age factor attitude on EMR use, Infrastructure/EMRs operation mode challenges such as frequent power blackouts, inadequate computers, lack of service point LAN (local area network), retrospective data entry, and hybrid EMR mode.	Organizational, Technological, Individual, and Ethical legal factors
Malawi	[67]	Mixed methods (Cross-sectional study, and focus group discussions)	Education, employment levels, hardware, and connectivity problems, lack of training, and managerial support.	Organizational, Technological, Individual, and Ethical legal factors
	[62]	Quantitative (Survey design of correlational type)	Inadequate funding, Inadequate management support, feedback, and training, and Lack of users training	Financial, Organizational, Technological, Individual, and Ethical legal factors
	[65]	Quantitative (descriptive cross-sectional study)	Internet issues, breach of privacy, work overload, incomplete patient information, inaccurate patient information, and power outage	Financial, Organizational, Technological, Individual, and Ethical legal factors

Nigeria	[5]	Quantitative (Cross-sectional study)	User perception of risk and security of data	Individual factors
	[95]	Qualitative (Interpretive and case study)	Government policy and strategy, lack of basic ICT knowledge/skills, lack of ICT infrastructure, poor internet connectivity, financial issues/constraints, and inadequate power supply	Financial, Organizational, Technological, Individual, and Ethical legal factors
	[94]	Quantitative (Pilot study)	Inadequate infrastructure, limited human capacity, brain drain, lack of enforcement of legislation and politics (political will), insufficient financial investment or incentives, and a corruption riddles system.	Financial, Organizational, Technological, Individual, and Ethical legal factors
	[61]	Mixed Methods (Quantitative: questionnaire. Qualitative: interview	Erratic power supply, inadequate funding, computer literacy level, and inadequate staff training and maintenance	Financial, Organizational, Technological, Individual, and Ethical legal factors
Ghana	[95]	Qualitative (Focus group discussions)	Poor quality of records, lack of involvement of frontline health workers in HER system development, inadequate training of staff, and limited workstations.	Financial, Organizational, Technological, Individual, and Ethical legal factors
	[96]	Qualitative (in-depth interview)	Inadequate equipment, lack of technical support, unfriendly software design, poor user interface and workflow issues, unreliable network, and internet connectivity, lack of funding, unreliable power supply, and lack of support	Financial, Organizational, Technological, Individual, and Ethical legal factors
	[97]	Mixed methods (non-interventional descriptive cross-sectional study and Qualitative: semi-structure interview)	Existing challenges such as financial resources, data entry errors, constraints of logistics, and human resource constraints, and perceived challenges such as data security	Financial, Organizational, Technological, Individual, and Ethical legal factors
	[98]	Qualitative (Non-systematic literature review)	Lack of training, user resistance, and lack of awareness of EHR	Financial and Individual factors

Source: Systematic Review of Literature by the Researcher, (2023).

Table 2 showed the challenges faced by LMICs in adopting and implementing EMRs/EHRs. Different authors over the years with different study types have identified that LMICs face various challenges in adopting and implementing EMRs/EHRs. Barriers such as inadequate funding, erratic power supply, inadequate infrastructure, poor internet connectivity, and political will were common with LMICs.

Table 3: Challenges Faced by HICs in Adopting and Implementing EMRs/EHRs

Country	Study, Year	Type Of Study	Challenges	Themes/Category
Australia	[23]	Qualitative (Case study	My Health Record (MyHR) applications regulations, MyHR data type applications, data access process, and testing regulations	Ethical-legal
	[99]	Qualitative (Case study)	Systemic challenges such as timeliness, contradictory incentives, High cost of implementation, privacy issues, and organizational structure	Financial, Ethical-legal, and Organizational factors
	[100]	Qualitative (interview)	Time burden, privacy, and confidentiality concerns.	Ethical-legal factors
	[101]	Qualitative (Structured, continuous observation)	Increase documentation time	Organizational factor
	[102]	Qualitative (Observation and semi-structured interviews)	Negative attitudes of stakeholders, and lack of readiness for change	Individual, and organizational factors.

Canada	[25]	Qualitative (Case study)	Governance (vision and political will, privacy, and data sharing regulations, and aligned financing structures), Contextual (Information system infrastructure, data quality, workforce capacity, and professional culture), Implementation (unharmonized standards and lack of regulations for EMRs)	Financial, organizational, and ethical-legal
	[103]	Qualitative (Systematic literature review)	Lack of stakeholders' engagement, system quality (inadequate performance and reliability, and security and privacy concerns).	Organizational, and ethical-legal factors
	[104]	Mixed methods: quantitative cross-sectional survey and qualitative (focus group discussion).	Navigation of EHR system functionality, organizational standards, documentation overload, system performance, and response time	Organizational, and ethical-legal factors
Germany	[31]	Qualitative (semi-structured interviews)	No standard documentation due to the highly fragmented healthcare system, interoperability issues, and political structure such as political will and incentive structures.	Ethical-legal barriers
Israel	[105]	Qualitative (interviews)	No standard data model, a variety of systems, and health information exchange issues	Ethical-legal, and organizational barriers
UK	[106]	Qualitative (structured interviews)	Cost of EHRs and uncertainty of the return on investment	Financial barriers
	[107]	Mixed methods: Quantitative (Surveys), Qualitative (Focus group discussion)	Technical issues, patient safety issues, unauthorized access to patient information, and data security concerns	Ethical-legal, and organizational barriers
	[108]	Mixed method (Quantitative: questionnaire, and Qualitative: semi-structured interview)	Lack of awareness, suboptimal communication strategies, inadequate training, lack of resources for dissemination of knowledge, inadequate support for the implementation and uptake of new systems, lack of end-user involvement, and privacy issues about patient confidentiality.	Individual barriers, and organizational barriers
US	[109]	Qualitative (Focus groups)	Poor interface, loss of productivity, system compatibility, inadequate IT support, hardware/software issues, inadequate training and education, patient factors, noise in the system, safety, data quality concerns, quality metrics, workflow, and malpractice concerns	Organizational, Technological, Individual, and Ethical legal factors
	[110]	Qualitative study (systematic literature search)	Initial cost, technical support, and concerns, resistance to changing workflow, training, privacy concerns, federal and state policies, the complexity of systems, and interoperability.	Financial, Organizational, Technological, Individual, and Ethical legal factors
	[111]	Qualitative (review of pertinent literature)	Lack of interoperability and standardization of interfaces among various systems, ineffective information exchange in the care of complex patients	Organizational and Technical factors
	[112]	Qualitative (systematic review of literature)	EMR system's functionality, utility, ease of use, and technical functionality, limited or poor training by vendors, limited learning resources about EMRs features	Financial, Organizational, Technological, Individual, and Ethical legal factors

Source: Systematic Review of Literature by the Researcher, (2023).

Table 3 revealed the challenges faced by HICs in adopting and implementing EMRs/EHRs over the years by different authors using different study types. Barriers common to HICs over the years range from safety and privacy issues, high cost of implementation, interoperability, time burden, and lack of standardization.

Research question 2: What are the current EMR/EHR implementation strategies in LMICs and how do these strategies differ from those used in high-income countries?

According to ([7], 2), the Installation and customization of information systems and their availability for use to support the delivery of services is referred to as system implementation. An example is the EHRs in healthcare. Table 4 showed EMR/EHR implementation strategies used in both high and LMICs.

Research question 3: How do social and cultural factors affect EMR/EHR adoption in low-income and high-income countries?

Findings:

1. Perceived Value and Benefits: several studies such as 98,93, 4, and 7, revealed that perceived value and benefits of EMR/EHR systems influence the adoption of EMR/EHR systems in LMICs, for Miles example, factors such as enhanced data management, increased efficiency, and improved patient care were highlighted as the major drivers for adoption. In HICs, perceived value and benefits are also influential in the adoption of EMR/EHR. For example, 14,107,92 emphasized benefits such as improved coordination of care, improved clinical decision-making, and reduced medical errors as key drivers for EMR/EHR adoption.
2. Privacy and Security Concerns: limited regulatory frameworks, patient privacy, and data apprehensions affect the adoption of EMR/EHRs in LMICs 18,9. On the other hand, privacy, and security concerns such as data breaches, unauthorized access, and misuse of patient information cause apprehensions among patients and healthcare providers which impact EMR/EHR adoption in HICs 23,100
3. Infrastructure and Technical Readiness: while HICs had better infrastructure and technical readiness, 23,113 identified incompatible or outdated systems, issues of interoperability, and high cost of implementation as factors that affect EMR/EHR implementation. On the other hand, factors such as inadequate internet connectivity, unreliable power supply, and inadequate IT infrastructure affect the adoption of EMR/EHR in LMICs 5,65.
4. Cultural Attitudes and Resistance to Change: in LMICs, cultural attitudes and resistance to change factors such as traditional practices, hierarchical structures, and reluctance to transition from paper-based systems affect EMR/EHR adoption efforts 114,118. Similarly, the preference for familiar practices, resistance from healthcare professionals, and workflow disruption concerns slowed the adoption of EMR/EHRs in HICs 31,25

4.1.4 Research question 4: What are the potential benefits and risks of EMR/EHR adoption in low-income and high-income countries?

Findings

1. Potential Benefits of EMR/EHR: Potential benefits of EMR/EHR systems in LMICs include improved patient care and safety, enhanced data access and management, streamlined workflows, and improved decision-making through data analysis 96. Similarly, improved care coordination, increased efficiency, reduction in medical errors, enhanced patient engagement, and support for evidence-based practices were potential benefits identified with HICs 113,117.
2. Risks of EMR/EHR: 58, and 4 highlighted the risks and challenges associated with EMR/EHR systems in LMICs to include the need for training and capacity building, data privacy, and security concerns, limited resources and findings, and inadequate infrastructure, and technical readiness while 106,112 and 119 identified risks and challenges common to HICs to include data privacy and security breaches, clinician burnout, workflow disruptions, potential errors resulting from issues with system usability, and high cost of EMR/EHR implementation and maintenance.
3. Equity and Access: with centralized or national EMR/EHR systems LMICs have the potential to improve equity and access to healthcare access in remote and underserved areas thereby facilitating better resource allocation 118. HICs on the other hand have the potential to enhance equity and access, however, 23, identified concerns about the digital divide and variations in access to technology, which could encourage healthcare inequalities.

Discussion of Findings

Discussion of Research Question 1

Research Question 1: What are the key challenges faced by LMICs in implementing EMR/EHR systems, and how do they differ from those faced by HICs?

A plethora of studies has revealed that LMICs face distinctive challenges in adopting and implementing EMRs/EHRs, which differ from those faced by HICs. For example, LMICs often have limited resources such as financial and technological resources to invest in EMR/EHR systems due to the high cost of implementing and maintaining these systems such as infrastructure development, software licenses, hardware, and training. This is

unlike HICs where financial incentives are awarded by the government to encourage the adoption and implementation of EMRs/EHRs and to augment the high cost of implementation 45,40. Infrastructure limitation is another challenge common with LMICs as shown in able 2. Many LMICs lack adequate technological infrastructure like unstable internet connectivity, unstable electricity supply, and inadequate supply of computer hardware 4. Also, interoperability is an issue in LMICs due to fragmented healthcare systems and a lack of standardization 5. Although data security and privacy concerns are challenges faced by both LMICs and HICs, however, data protection mechanisms such as encryption, secure storage, and access controls are far from being achieved in LMICs due to limited resources as identified by 7. Furthermore, other challenges peculiar to LMICs as shown in Table 2 include a lack of technical expertise due to a shortage of skilled IT professionals and trained healthcare practitioners in the use of EMRs/EHRs, and social, behavioral, and cultural factors such as resistance to change. Aside from healthcare practitioners, patients may have concerns about the reliability and confidentiality of electronic records.

In contrast, HICs in general have more resources and infrastructure to tackle most challenges. However, they are faced with different barriers as shown in Table 2 such as:

1. High cost of maintenance: notwithstanding that HICs are likely to adopt and implement EMR/EHR systems, the initial investment, continuous maintenance, and upgrades can drain healthcare budgets.
2. Data privacy and concerns: although data protection and concerns affect both LMICs and HICs, HICs are likely to face more sophisticated cyber threats and attacks due to the high value of healthcare data. Therefore, robust cybersecurity measures are crucial to protecting patient information from breaches and unauthorized access.
3. User adoption is also a challenge in HICs because healthcare practitioners are likely to resist adapting to new digital systems and changes in their workflow.
2.Standardization and interoperability are ongoing challenges in HICs due to various EMR/EHR vendors and implementations. This prevents effective data exchange and the development of standard protocols and data formats.

According to 119, challenges such as EHR Systems (poor system integration and interoperability, lack of trust and belief in EHRs, and system quality), Support for Healthcare Providers/Staff (poor training and technical support, lack of user involvement, and literacy and skill in technology), Data and Information (privacy and security of data, data quality, and accuracy and other concerns such as low awareness, legal liability, and resource constraints are common with both high and LMICs

Discussion of Research Question 2

Research Question 2: What are the current EMR/EHR implementation strategies in LMICs and how do these strategies differ from those used in HICs?

According to 118, and 7, the adoption and implementation of EMRs in LMICs are at the National- level, either as an isolated or pilot implementation or large-scale rollout of systems. For example, Kenya has had over 1000 EMR systems in both private and public health facilities progressively since 2012. However, these EMR systems are focused mainly on supporting data management on Human Immunodeficiency virus (HIV) and Tuberculosis (TB) care and treatment funded by programs such as the US President's Emergency Plan for AIDS Relief (PEPFAR) although evidence on the extent of use of the implemented EHRs is not known 115, 764).

The implementation of EMR or EHR systems needs tailored strategies irrespective of the setting where it is being implemented. The findings of this study revealed 4 EMR/EHR implementation strategies common to LMICs which are:

1. Government-led Initiatives/Comprehensive or Incremental Implementation: Most of the EMR/EHR projects are pilot projects where smaller-scale projects are started over time and expanded gradually due to limited resources.
2. Open-Source Solutions: Open-Source EMR/EHR systems are frequently utilized by LMICs because they offer affordability, flexibility, and customization options to meet local needs.
3. Mobile and Cloud-Based Solutions are also common with LMICs due to infrastructure limitations. Therefore, mobile and cloud technologies are leveraged to access EMR/EHR through tablets or smartphones and
4. Bottom-Up Approach: where small-scale EMR/EHR systems projects are commenced at the primary healthcare level and subsequently expanded to the tertiary healthcare level.

In contrast, HICs often use comprehensive and large-scale implementation, top-down approaches, vendor-led initiatives, and collaborative and change management approaches as well as open-source because the financial means are planned to cover multiple healthcare facilities and regions. With advancements in technology, any of these strategies can be adopted by any country depending on their specific circumstances, availability of resources, and priority of healthcare.

Discussion of Research Question 3

Research Question 3: How do social and cultural factors affect EMR/EHR adoption in LMICs and HICs?

Social and cultural factors play key roles in the adoption of EMR/EHR systems in both HICs and LMICs. The key themes that emerged across kinds of literature are perceived value and benefits, infrastructure and technical readiness, privacy and security concerns, and cultural attitudes and resistance to change. Therefore, understanding these factors is crucial in developing EMR/EHR implementation strategies. Also, policymakers in healthcare organizations should focus on solving problems of gaps in infrastructure, data privacy, and security concerns, designing interventions that allow cultural nuances while promoting EMR/EHR systems' perceived benefits. In addition, knowledge sharing and international collaborations between LMICs and HICs will facilitate learning and effective support of EMR/EHR systems adoption in both settings.

Discussion of Research Question 4

Research Question 4: What are the potential benefits and risks of EMR/EHR adoption in LMICs and HICs?

Findings from this study revealed significant potential benefits in both HICs and LMICs and these include improved patient care, enhanced data management, streamlined workflow, and improved clinical decision-making. On the other hand, risks such as privacy and security concerns, infrastructure limitations, interoperability issues, and financial burdens were identified. However, to mitigate these risks, healthcare organizations and policymakers should focus on improving infrastructure and technical readiness, addressing data security and privacy concerns through the development of standard policies and regulations, encouraging interoperability between systems, capacity building and provision of training, and adopting sustainable financial models. Consequently, equitable distribution of resources will be achieved thereby preventing digital divide and disparities.

Strategies for Implementing and Adopting EMR/EHR Systems in Both HICs and LMICs

Findings from this study showed that developing strategies that consider the local context, availability of resources, and infrastructure is crucial to ensuring the successful adoption and use of EMR/EHR systems in both HICs and LMICs. Therefore, the key strategies needed to develop an effective implementation plan are highlighted below:

1. Conduct a Needs Assessment: this is done to identify the specific local context requirements and should include an evaluation of available resources, local healthcare infrastructure, legal and regulatory frameworks, and the specific healthcare challenges faced in the area.
2. Create and Engage Local Stakeholders: It is essential to create and engage local stakeholders in the implementation plan to ensure buy-in and support from local healthcare practitioners and patients. For example, these stakeholders can include healthcare providers, community leaders, patient advocates, and government officials.
3. Adapt EMR/EHR Systems to Local Context: to ensure EMR/EHR systems are relevant and effective, they should be adapted to the local context which involves customization of the system to include local languages, adapting the user interface according to the specific needs of the healthcare providers, and the integration of features that address specific healthcare challenges faced by a healthcare organization.
4. Training and Support Programs: A comprehensive training and support program that trains healthcare providers on how to adequately use EMR/EHR systems should be developed to ensure the successful adoption and use of EMR/EHR systems while addressing ongoing challenges that may arise.
5. Address Infrastructure and Connectivity Issues: to address this issue, especially in LMICs, it is necessary to invest in local infrastructure improvement such as the provision of reliable power sources, establishing Internet connectivity, and provision of devices that can work in low-resource environments such as OpenMRS in Kenya 7.
6. Ensure Data Security and Privacy: it is essential to establish robust data security and privacy protocols to ensure the protection of patient data. This may include breach reporting procedures, user access controls, and data encryption.
7. Develop a Sustainability Plan: this involves outlining how EMR/EHR systems will be maintained and upgraded over time to ensure their long-term use. This can include system updates, maintenance, and funding 121,122.

If these strategies are considered, adopting, and implementing EMR/EHR systems can be achieved in any country because local contexts, available resources, and infrastructures will be considered.

V. Summary, Conclusion, and Recommendations

Introduction

EMR and EHR systems are now widely acknowledged as important instruments for enhancing patient safety, healthcare management, and healthcare delivery. These systems' adoption and deployment are essential for changing healthcare procedures and improving patient outcomes. However, several variables, like a nation's

income level, might affect how successfully EMR/EHR systems are adopted and used. When it comes to deploying EMR/EHR systems, HICs and LMICs confront distinct difficulties and have varied resources. High-income nations frequently have better healthcare infrastructures, more money, and more technical know-how, allowing them to adopt and put in place comprehensive EMR/EHR systems at the national level. The implementation process is more difficult in low- and middle-income nations because of their poor technology infrastructure, resource restrictions, and variety of healthcare environments. Till the moment, EMR/EHR implementation strategies have received little attention from researchers, with most of their attention going to high-income nations. To find successful tactics that may be modified for various settings, it is necessary to analyze and compare the strategies used by these two groups of countries. Policymakers, healthcare professionals, and stakeholders can learn more about solutions that have worked well in different income contexts by doing a comparative analysis. This will help them make better decisions and get better implementation results. By performing a thematic systematic literature review to evaluate and contrast the adoption strategies, this study seeks to fill this knowledge vacuum and put EMR/EHR systems in place in both HICs and low-middle-income nations. This study pinpoints successful tactics that can be adjusted to various income circumstances by synthesizing existing knowledge and looking at the experiences and difficulties faced by each group of countries. The study considered several aspects that affect the deployment of EMR/EHRs, including interoperability, infrastructure, technical know-how, and cultural issues. It examined the parallels and discrepancies between the tactics used in high-income and low-middle-income nations and evaluated how these strategies handle the difficulties unique to each group. The results of this study can help design evidence-based implementation strategies for EMR/EHRs that take into consideration the contexts and resources that exist in high-income and low-middle-income nations. Policymakers and healthcare stakeholders may support the wider use of EMR/EHR systems and improve implementation outcomes by identifying and exchanging best practices. This will improve healthcare delivery and patient care on a worldwide scale.

Summary

To improve healthcare procedures and patient outcomes, EMR/EHR systems must be adopted and put into use. However, due to disparities in resources and healthcare environments, the tactics used in this process can vary across HICs and LMICs. To compare the implementation techniques for EMR/EHR in these two income levels, this study conducted a comprehensive thematic evaluation of the literature. Relevant research on EMR/EHR implementation tactics in high and LMICs was evaluated in the review. Data extraction was done to find recurring themes and patterns in the tactics used. Based on the similarities and contrasts between the techniques, thematic analysis was used to group them into distinct themes. The findings outlined successful tactics employed in HICs such as extensive and widespread deployment, and a focus on interoperability and standardization. On the other hand, low- and middle-income nations used approaches including incremental deployment, open-source solutions, and reliance on mobile and cloud-based technology to get around infrastructural constraints.

The comparative analysis highlighted parallels and discrepancies between the two income groups' methods. While improving healthcare practices was the main priority for both groups, HICs placed more emphasis on comprehensive functionalities, interoperability, and standardized procedures while LMICs adapted their tactics to deal with resource restrictions, infrastructure problems, and regional healthcare customs. The results of this study revealed effective EMR/EHR implementation strategies in various national contexts. These insights can help policymakers and healthcare stakeholders create effective plans that consider the difficulties and resources available in various socioeconomic contexts. Global healthcare improvement through widespread EMR/EHR adoption can be aided by exchanging best practices and lessons gained.

This comparative analysis emphasizes the need to understand EMR/EHR implementation tactics and the significance of context-specific techniques to improve and adapt these techniques to suit the changing demands of healthcare systems worldwide. Therefore, additional studies and cooperation are required.

Conclusion

To successfully adopt EMR/EHR systems, it is necessary to develop solutions that are specifically suited to the needs of HICs and LMICs. The comparative analysis of EMR/EHR implementation tactics in these two income categories has allowed for insightful conclusions to be drawn from this study, as well as the identification of crucial factors for successful implementation. Comprehensive and widespread implementation, government-led initiatives, and a focus on interoperability and standardization have been important tactics in HICs. These nations have been able to adopt and operate EMR/EHR systems across the country, integrating various healthcare facilities and ensuring smooth data exchange thanks to their developed healthcare infrastructures and financial resources. On the other hand, LMICs have adopted tactics that put an emphasis on resource optimization and context-specific flexibility. These nations have been able to overcome infrastructural and resource constraints using open-source software, incremental implementation, and mobile and cloud-based technologies. These tactics

have promoted EMR/EHR implementation flexibility, cost, and accessibility, enabling healthcare professionals in many contexts to take advantage of digital record-keeping.

Despite having different approaches, both high-income and low-middle-income nations strive to improve healthcare management, patient care, and patient outcomes by using EMR/EHR systems. Countries in both income levels can accomplish these objectives by coming up with and putting into practice successful tactics, albeit through methods catered to their unique situations and resource limitations. The results of this study highlighted the significance of context-specific strategies for EMR/EHR implementation. Due to budget constraints and distinctive healthcare systems, strategies that have been proven effective in high-income nations may not be directly relevant or practical in LMICs. Therefore, when establishing and implementing EMR/EHR initiatives, policymakers, healthcare practitioners, and stakeholders must consider the local environment, infrastructure, resources available, and cultural aspects.

Also, this study highlighted the importance of information exchange and cooperation between HICs and LMICs. While the inventive and resource-efficient ways used by LMICs can provide insights to HICs facing comparable issues, successful strategies, and best practices from HICs can be invaluable resources for LMICs. This comparative analysis of EMR/EHR implementation strategies in high and LMICs in conclusion, lays the groundwork for evidence-based policy formation. Countries can adjust their strategy to optimize the adoption and implementation of EMR/EHR systems by understanding the distinct opportunities and obstacles experienced by each income group, ultimately resulting in improved healthcare outcomes and patient care on a global scale. EMR/EHR deployment strategies and sustainable healthcare reform require ongoing research, knowledge exchange, and collaboration.

Recommendations

The following suggestions are made considering the results of this comparative analysis of EMR/EHR implementation techniques in HICs and LMICs:

1. Adjust Strategies for the Context: Recognize the significance of context-specific strategies while implementing EMR/EHR. Concerns including financial resources, technology capabilities, and cultural concerns should be considered when tailoring strategies to the unique healthcare settings, infrastructure, and resources of each nation. In environments with a wide range of socioeconomic levels, one-size-fits-all strategies might not work.
2. Collaboration and Knowledge Transfer: Encourage cooperation and knowledge exchange between high-income and low-middle-income nations. Low-middle-income nations can give creative and resource-efficient solutions to specific problems, while high-income nations can impart best practices, lessons learned, and technical breakthroughs to low-middle-income nations. Establishing sharing networks, alliances, and platforms for EMR/EHR installation can be accelerated globally by knowledge and skill.
3. Incremental Implementation: Consider implementing incremental solutions, especially in low- and middle-income nations with weak infrastructure and resources. Healthcare facilities can overcome obstacles step by step by gradually scaling up EMR/EHR systems, which lowers implementation costs, minimizes interruptions, and optimizes resource allocation. This strategy encourages sustainability and allows for ongoing learning and development.
4. Open-Source Options: Investigate the use of open-source EMR/EHR solutions, particularly in low- and middle-income nations. Open-source systems provide affordable alternatives, encourage interaction between users and developers, and promote modification to address unique regional demands. Governments and organizations can aid in the creation and uptake of open-source solutions by providing funds, enhancing capabilities, and exchanging expertise.
5. Enhance interoperability by highlighting its significance in EMR/EHR implementation techniques. Standards and protocols that promote seamless data sharing and interoperability between various healthcare systems and providers should be given top priority in both high-income and low-middle-income nations. To maintain compatibility and encourage interoperability across borders, work with global organizations and standards bodies.
6. Capacity Building and Training: Invest in programs that will increase the technical proficiency of healthcare professionals and IT staff involved in the adoption of EMR/EHR. Give thorough instructions on data management, privacy and security, and strategies for
quality improvement. Continual professional development should be encouraged to stay current with new technologies and recommended procedures.
7. Assess the Effectiveness and Impact of EMR/EHR Implementation Strategies: Establish Reliable Evaluation Mechanisms. System adoption rates, data quality, user happiness, and patient outcomes are a few examples of critical performance indicators to keep an eye on. Review and evaluate the findings frequently to spot problem areas and direct further implementation efforts.
8. Regulatory and Policy Frameworks: Create regulatory and policy frameworks that support the introduction of EMR/EHR. Regarding data privacy, security, and secrecy, governments should create precise rules, criteria, and

regulations. Encourage the adoption of EMR/EHR systems by healthcare facilities and providers through financial incentives, reimbursement plans, and legal regulations.
9. Encourage collaboration between the public and private sectors in the implementation of EMR/EHRs: Utilize the knowledge, resources, and innovations of private technology businesses, vendors, and stakeholders. Public-private collaborations can make it easier to create, modify, and maintain EMR/EHR systems, assuring their sustainability and ongoing technical innovation.
10. Long-Term Planning and Support: Be aware that implementing an EMR or EHR is a lengthy process that calls for continual support and dedication. Governments and healthcare institutions should devote enough financial and human resources to maintaining and advancing EMR/EHR systems. Create long-term implementation strategies that include clauses for system updates, upkeep, and continuous user assistance.

Regardless of their income level, countries can increase the adoption and deployment of EMR/EHR systems by putting these ideas into practice. Global EMR/EHR technologies and practices are constantly improving, which will lead to better patient outcomes, population health management, and healthcare delivery. It is crucial to stress that these suggestions should be tailored to the unique requirements and conditions of each nation. Effectively adopting EMR/EHR systems requires adaptability, teamwork, and a desire to learn from both positive and negative experiences.

Additionally, it is critical to keep researching and disseminating information on EMR/EHR deployment methodologies. Ongoing research can examine the efficacy of various strategies in greater detail, assess the long-term effects of EMR/EHR systems, and pinpoint new developments and trends. Collaboration in research can help create best practices and evidence-based recommendations for successful global implementation.

In conclusion, careful planning, specialized methods, and stakeholder cooperation are necessary for the adoption and deployment of EMR/EHR systems. High-income and low-middle-income nations can exchange knowledge and proven tactics to better their own circumstances. Countries may improve the adoption and deployment of EMR/EHR systems, hence improving healthcare outcomes and enabling sustainable healthcare transformation on a global scale, by utilizing existing knowledge, encouraging collaboration, and putting these ideas into practice.

Limitations of the Study

While the goal of this study was to offer useful insights into the adoption and implementation techniques for EMR/EHR systems in high-income and low-middle-income countries, it is vital to recognize some limitations:
1. Literature Bias: The study depended on a thorough evaluation of the literature, which could be biased toward certain publications. Only including research that has been published could lead to the exclusion of unpublished or gray literature, potentially reducing the thoroughness of the results.
2. Language prejudice: Since papers published in languages other than English were not included, the review may have been constrained by language prejudice. Relevant studies carried out in non-English-speaking nations that would have offered additional insights into EMR/EHR implementation strategies could be excluded as a result.
3. Lack of Primary Data: No primary data collection was done, and the study only used available literature. Although the systematic literature review offers a thorough summary of the studies that have already been conducted, the lack of primary data gathering may limit the scope of the analysis and the capacity to gather nuanced insights.

This study adds to the body of information on EMR/EHR implementation strategies in HICs and LMICs despite its limitations. Future studies should incorporate a wider variety of studies, take into consideration primary data collecting, and consider developing trends and developments in the field to solve these constraints.

Areas for Further Research

Further areas of study include:
1. Evaluation of cost-effectiveness and sustainability of EMRs/EHRs in high-income and low-middle-income countries.
2. Impact of EMRs/EHRs on clinicians' workload and patients' satisfaction in high-income countries and low-middle-income countries.
3. The role of public-private partnerships in the adoption and implementation of EMRs/EHRs in high-income and low-middle-income countries and
4. The exploration of the ethical and legal implications of EMRs/EHRs adoption and implementation in high-income and low-middle-income countries.

A deeper understanding of the implementation strategies of EMRs/EHRs in high-income and low-middle-income countries can be achieved with further research on these areas, consequently informing the development of more effective and sustainable implementation strategies.