

Adoption of Electronic Health Records in Pathology: Challenges and Opportunities

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ABSTRACT

An Electronic Health Record (EHR) is an automated representation of a patient's medical history that healthcare workers record over time. It may encompass all the critical managerial clinical data pertinent to that person's care with a specific provider, such as demographics, progress records, difficulties, prescriptions, vital signs, past medical history, immunizations, laboratory results, and radiological reports. The EHR modernises access to information and has the potential to improve clinical workflow. The EHR can also assist with other care-related duties, either directly or indirectly, through various mechanisms, such as evidence-based decision support, quality monitoring, and reporting. EHRs represent the next phase in the evolution of healthcare, with the potential to enhance patient-clinician interactions and improve patient care. The data, its suitability, and availability will enable clinicians to make more informed decisions and provide more effective therapy. For example, an EHR can enhance patient care by increasing the accuracy and clarity of medical records, thereby reducing errors and improving overall patient outcomes. Second, improve access to health information, eliminate test repetition and treatment interruptions, and empower patients to make informed choices. Third, the accuracy and clarity of medical records should be improved to reduce errors.

Keywords: Adoption (AA), Electronic Health (EH), Pathology (PP), Challenges (CC), Opportunities (OO)

INTRODUCTION

The medical history of a patient, as managed by the person providing it over time, is called an electronic health record. It may also involve all the data related to the clinic and that person whose history is under study. This is performed under the supervision of a provider. The components involved in it are demographics, progress notes, problems, and medication. The main components of clinical health records are five clinical data repositories, a decision support system, and an entry system based on order. This platform is centred on the patient and a system for reporting. Electronic health records are a platform that provides numerous advantages to individuals with diseases and healthcare providers alike. The factors involved in this phenomenon include efficiency, accessibility, protection, and the quality of care provided to patients[1]. Dashboards provide a simultaneous view of multiple patient types, as well as indicators focused on clinics and patient data. Electronic health testing is a highly beneficial tool that provides access to diagnostic testing for all patients, allowing for the detection of changes in laboratory data. A notable example is the use of cardiac enzymes. All guidance regarding the patient's healthcare is managed to ensure it can be accessed by anyone, thereby ensuring proper care is provided to the patient. Electronic health records primarily focus on the following points: privacy and confidentiality, security, breaches, system implementations, and the inaccuracies and shortcomings found in patient health records. The electronic health records system is already working very well, but certain steps can be taken to improve it further [2]. Building certain rules and standards for the processing of data entry. Introduce a system that allows users to operate easily. Ensure the interoperability of that specific system with other systems. It should be a source of training that proves very informative and comprehensive for the people working with it. It should be software that can be optimised easily and updated regularly. Introduce methods that prioritise security and are highly authentic. The user's demands are based on seven different types of appointments, patient billing, clinical

charts, data entry orders, patient approaches, general documents, and data reporting. The primary demand for this system is the need for ongoing maintenance and updates over time. This type of system is susceptible to technical problems[3]. The settings of this system are not compatible with all devices and software types. Data security issues and privacy concerns also arise when this system is implemented. The major benefit of this system is that it will decrease the risk of medical problems because all the data is directly put into the system. Electronic health records bring harmony among healthcare providers. [4] Electronic health records prove to be the best platform for serving as a patient engagement tool. The widespread adoption of electronic health records and the growing trend of utilising information sources about patients are signs of the development of big data, which is the primary source of improvements in clinical research in the field of oncology, focusing on the origin of existence. The research conducted at that time was highly authentic and more effective than today's research, which is often performed manually and considered a very high standard [4]. However, electronic health records have many limitations and drawbacks. Some of them are discussed below. There is a lack of many important data elements. Some elements are only mentioned in free text or found in PDF-formatted documents. After studying cases, it can be concluded that certain challenges are encountered when leveraging the data regularly accumulated by the healthcare system [5]. Some of the most well-known challenges in this field can be seen in the cancer domain. The opportunities in this field become clear when all these problems are overcome. Electronic health records are a central point of discussion in various federal government strategies and have become a significant topic in the healthcare field. The most recent steps, which focus on the use of electronic health records and are devised by the federal government, have the primary objective of planning and promoting certain key implications that can be applied in laboratories and pathology practices. Under the Health Information Technology for Economic and Clinical Health Act, an

incentive program known as the Electronic Health Record (EHR) is established, which enables physicians and hospitals to qualify for payments by demonstrating meaningful use of certified EHR technology[6]. By utilising EHR technology, meaningful use has been certified based on technical and functional criteria [7]. All the actions and regulatory strategies benefit pathology laboratories for several reasons[8]. Many requirements for their meaningful use and EHR certification criteria are related to laboratory testing and laboratory management techniques, either directly or indirectly [9, 10]. An electronic health record (EHR) digitally stores patient and population health information. These records can be shared across different healthcare settings. Records are spread through networked, enterprise-wide information systems or other information networks and exchanges. EHRs can contain a vast range of information, including demographics, medical history, prescription and medication information, immunisation status, laboratory test results, radiographic images, vital signs, personal characteristics such as age and weight, and billing information. For periods, electronic health records (EHRs) have been relied on to improve patient care. Electronic health records are utilised for more than just patient documentation; physicians are leveraging data from patient records to improve quality implications via care management systems.

EHR combines all patients' demographics into a vast pool and uses this data to aid in establishing "new treatments or innovation in healthcare delivery," ultimately advancing healthcare aims. By combining different forms of clinical data from the system's health records, practitioners were able to identify and stratify chronically unwell individuals. EHR can improve the quality of care by using data and analytics to prevent hospitalisations among high-risk patients. EHR systems give reliable data and follow patient status over time. It reduces the need to retrieve a patient's previous paper medical records while ensuring that the data is current, accurate, and legible. It also enables unfettered contact between the patient and the practitioner while protecting "privacy and security." Because there is only one changing file, it lessens the danger of data replication, increases the likelihood that the file is current, eliminates the possibility of lost documentation, and is cost-effective. Because digital information is searchable and preserved in a single file, EMRs (electronic medical records) are more effective at retrieving medical data for detecting potential patterns and long-term changes in a patient. The expanding use of EHRs and EMRs may make population-based medical record research more practicable.

Research Objective

The main reason for studying this article is to understand the benefits of adopting electronic health records in the pathology department. The application of this technique enables one to understand all the challenges, facilities, and opportunities in this field.

LITERATURE REVIEW

Researchers explain that the trend of using AI in the health field is increasing due to the numerous applications provided by AI to the health sector. AI is an intelligence-based system, and its use in the healthcare sector minimises health record errors. The process of treating medical patients has undergone significant revolutionization with the help of AI in the health field [11]. Studies reveal that modern technology has enhanced blockchain by facilitating the storage of electronic health records. Fragmented health records related to a

patient's medical state are now compiled into large data reports using blockchain technology. Hospitals that utilise this technology offer advanced and enhanced medical services to their patients [12]. Studies have shown that the process of providing complex medical services to patients has been enhanced through the use of AI-based deep learning algorithms. These algorithms are used in the healthcare sector to optimise the performance of services provided by physicians to their patients. The anatomy pathology labs use AI to ease the cancer detection process[13]. Studies suggest that the rebate of mortality caused by cancer is predictable through ADR. For analysing large electronic health data reports, the ADR is combined with automated systems. The automated systems improved the ADR's ability to detect cancer incidence rates by analysing EHR Reports [14]. Studies show that anatomical pathology is a field that has advanced through the use of innovative systems. The improvement in the genomic labs has enabled the identification of microscopic objects. The process of obtaining data for data analysis has become easier with the use of deep learning algorithms. By integrating digital systems in pathology labs, the overall performance of these labs improves [15]. Studies suggest that in healthcare sectors, infection management teams utilise Electronic Health Records (EHRs) to obtain data related to the incidence of infectious diseases. The infection management team utilises machine learning (ML) to obtain data from electronic health records (EHR) [15]. Studies explain that clinical decisions are based on medical evidence. To assess the clinical decision process, a data analyst team is made. The data analysis team utilises AI technology to verify the accuracy of clinical decisions made by healthcare professionals. The process of early decision analysis is essential to ensure that the patient receives the best possible clinical treatment [16]. Studies predict that all information related to patients' health statistics is stored in an Electronic Health Record (EHR). Maintaining error-free Electronic Health Records (EHRs) is crucial to ensure that no patient health information is compromised. The information related to the patient medical disease condition, the treatment-based medication, and the patient's response to medical treatment is provided by EHR[17]. Studies indicate that vast amounts of medical data are generated daily in hospitals and other healthcare sectors. This data holds great clinical importance and is saved in digitalized form to reduce error chances. Medical data is digitalised for use in AI technology systems, which are used for digitalising medical records. The medical data in digital form is regarded as an Electronic Health Record (EHR). EHR serves two main functions. The primary function of an EHR is to facilitate the medical treatment process [18]. The secondary function of EHR is to aid in the clinical research process[6]. Additionally, an EHR is developed to store the medical data of individual patients and groups of patients. The data stored in EHR is of two types. One is structured data, and the other is unstructured. Both these data forms serve one main purpose, which is to provide valuable information related to the patient. Unstructured data sometimes creates numerous challenges, but these challenges are tackled using the most advanced AI algorithmic approach [9]. Studies reveal that health records related to patients from 2009 to 2018. These health records are national health records that provide an overview of the health statistics of patients nationwide [19]. Studies suggest that clinical data can be extracted from EHRs through NLP. The utilization of NLP is less due to limitations in the automation process. Using AI helps improve the automation of medical health records[20]. Studies have shown that utilising AI in the healthcare sector accelerates the process of disease diagnosis and identification. Using advanced AI,

patients are provided with early intervention[21]. Studies show that for pathologists, digital pathology is a concept rooted in mathematics and engineering. DP is a computer-based program that assists pathologists in diagnosing diseases. The implementation of digital pathology as a computer-based system in pathology labs has enhanced the accuracy of results provided by these labs[22].scholars explained that medical imaging technology is AI AI-based technique that provides detailed information. Medical imaging technology plays a role in data analytics by analysing the data and providing related insights [23].Scholars' studies provide evidence that suggests some social factors affect patients' health. these factors are termed SDoH. By estimating the extent to which these social determinants affect a person's health, it becomes easier to develop an efficient clinical strategy. The estimation process is done using EHR. Electronic health records provide detailed information about the various social factors that negatively impact the health of patients with different diseases [24]. Studies reveal that in histopathology labs, the diagnostic test is carried out using whole-slide imaging (WSI). The research system of most complex and multicenter hospitals utilises DP to diagnose the health conditions of their patients [25]. Studies suggest that the use of deep learning algorithms is employed in pathology labs to encode the data of electronic health records.To understand the methodology behind big data, the deep learning algorithm holds importance. Additionally, EHRs are specifically developed to provide deep insights related to a patient's medical status [26].Studies predict that retrieving patient information from EHRs is possible using AI. AI improves the accuracy of data obtained from the retrieval process. Moreover, machine learning techniques are used in labs to ease the work-related load on physicals. Certain difficult tasks, such as the detection of tumour cells, are still performed by physicians and not through machine learning.By understanding the correct use of AI in labs, various lab research processes can be accelerated. However, the challenges created by AI in pathology labs have made it a technology that has great hype, but it provides less hope to physicians [27].Researchers predict that there is a certain variation in the patterns of obtaining data from the EHR in the US and other states. In different states, the time devoted to retrieving patient data from EHRs varies; therefore, the precision of data varies in these countries [28].

Ensuring Long-Term Record Preservation and Storage

Planning for long-term preservation and storage is vital when creating electronic medical records. The field must agree on how long to store EHRs, how to secure the future accessibility and interoperability of conserved data with yet-to-be developed retrieval technologies, and how to protect the physical and virtual security of the archives. Electronic health records can be utilised indefinitely and integrated across multiple care organisations, complicating long-term storage decisions. Numerous organizations can create, use, alter, and view records. Examples of such organisations include primary care providers, hospitals, insurance companies, and individuals. As predicted by Mandl et al., "choices about the structure and ownership of these records will have a significant impact on the accessibility and privacy of patient information." National and state rules regulate the mandatory storage time for electronic health records, which might alter over time. Ruotsalainen and Manning determined that patient data has an average preservation time of 20 to 100 years. In one example of how an EHR archive may operate, their research "describes a cooperative trusted notary archive (TNA) which receives health data from various EHR-systems, stores data together with associated meta-

information for long periods, and distributes EHR-data objects. "TNA may store objects in XML format and use event records, timestamps, and archive e-signatures to ensure the integrity of saved data." Ruotsalainen and Manning described a TNA archive, but various EHR/archive system combinations are feasible. Again, the general criteria for the architecture and security of the system and its archive will vary. Still, they must be consistent with ethical and legal considerations unique to the period and place. EHRs are expected to last longer than paper records, while the actual duration is unknown. As technology advances, the programs and systems used to enter information are unlikely to be available to a user who wants to evaluate preserved data. One potential solution to the challenge of ensuring long-term data accessibility and value in future systems is to standardise information fields in a time-invariant manner, such as using the XML language. According to Olhede and Peterson, "the basic XML format underwent preliminary testing in Europe by an SPRI project and was found suitable for EU purposes." Spri has requested that the Swedish National Board of Health and Welfare and the Swedish National Archives provide recommendations on utilising XML as an archive format for EHCR (Electronic Health Care Record) data. An electronic health record (EHR) is a collection of longitudinal electronic health data for individual patients and populations. Generally, EHRs are designed to record healthcare information, although they also contain a wealth of valuable data that is beneficial for many other purposes. For instance, EHRs provide an efficient way of communication, fewer medication errors, and cost-effective methods, facilitating the sharing of information among clinicians, improving healthcare quality, and enabling efficient management of patient records, to enhance the care sector. As the amount of information about patients increases rapidly, expertise is required to analyse this large dataset and extract meaningful insights from it. Data stored in EHRs consists of various formats, including graphics, symbols, free text, and numbers. The formats used in Electronic Health Records (EHRs) are classified into two types: structured and unstructured. The data for structured kinds stored in EHRs includes demographic details of patients, such as gender, age, height, blood pressure, medications, and weight, as well as laboratory reports. These data types can be easily achieved with less effort by utilising standard statistical or machine learning models, as most of the data typically exists in a stable structure. The data in unstructured types stored in EHRs includes narrative information, clinical notes, surgical data, a discharge summary, radiology and pathology reports, and clinical images. These types of data are complex and exist in irregular form.

Electronic Health Record

Earlier, when a patient visits the doctor in the clinic, it is the doctor's responsibility to assess the patient with care, using randomised clinical trials (RCTs) to provide the best treatment. However, the data from these trials need to provide more information, as many health-related questions have not been adequately studied using this method. The RCT method also does not provide strong evidence, and all patient data must be accurately recorded. For instance, RCTs study dismisses the sick and aged people, and outcomes do not apply to everybody. Moreover, precision medicine issues are also a significant challenge when using the RCTs method. Conversely, electronic health records (EHRs) are an efficient method that directly collects information from clinical locations. Real-world data are collected from clinics during everyday schedules, which is considered the "point of care" records. It is possible to add individual patient data and population data to many

datasets characterised by various disease sections. EHRs are considered a crucial tool for clinical studies, enabling the extraction of individual patient data from large datasets with the aid of machine learning models. Electronic health records are a comprehensive term used to record health-related data in digital form. In pathology labs, various tests have been conducted, including analysis, treatments, and the recognition or cure of contagious diseases. The role of EHRs in pathology labs demonstrates that different experts can analyse individual patient reports simultaneously, and the requirement for repetitive laboratory tests can be reduced with this method. For instance, if an individual's lab reports indicate that they have an infectious disease or cancer, their data will be recorded in the computer for further analysis, and there is no need for a lab test again. When it comes to opportunities related to EHRs in the pathology sector, pathology reports often include cancer information, such as the stage of the tumour, type of tumour, and other relevant details. This information is used to collect statistical data and documentation. In Norwegian cancer reports, there is a statistical code that requires a manual process and is time-consuming. This can be overcome with the help of machine learning techniques, such as those used in electronic health records, which contain pathology codes. EHRs also increase the rate of work completed in the laboratories without consuming a significant amount of time. EHRs must be integrated into pathology labs to access patient data, medical history, and test reports, among other information. This method can enhance the decision-making capabilities of pathologists and improve patient care. The challenges EHRs face include applying the EHR approach to existing laboratories, which complicates matters and necessitates customisation, a process that takes time. In pathology labs, there is information about patients' reports and history, and it is critical to handle such confidential information. Maintaining the privacy and security of data is the biggest challenge faced by using EHR systems in pathology labs.

Challenges Associated with EHR

The use of electronic systems in pathology labs for digitising patient data is a challenging task. Various challenges faced in EHR implementation in pathology labs are as follows: 1. The high prices of electronic devices make their implementation a costly task. Implementing an EHR at a small scale is a challenging process, as collecting funds for this purpose is difficult. Setting up a personalised pathology lab by investing in personal labs is also one of the challenges faced during EHR implementations in pathology laboratories. Funding upfront is established to solve the challenges related to the high cost of EHR equipment or devices. 2. To use the EHR system efficiently for data storage, the medical staff must be trained in the complex EHR system. Training healthcare staff on the use of EHR-based devices is a significant challenge in pathology labs, as it is a time-consuming process. It requires a lot of time and attention to provide medical staff with training sessions. This problem creates hurdles in the implementation of EHR in pathology labs' working infrastructure. To tackle the complications of these training challenges, a thorough and simplified training program is implemented for medical staff and pathologists. The simple training programs educate staff on the use of EHR systems in a short period. 4. The third challenge that pathology labs face in EHR implementation is the need for more technology-related knowledge among staff. Any technical problem with the use of EHRs causes the staff to lose interest in the training process. The lack of knowledge regarding advanced

technology makes the training staff unable to understand the technical steps of the EHR system. To avoid this problem, the medical staff is provided with knowledge related to the most recent and advanced technological terms and concepts. This step is essential to broaden the medical staff's understanding of implementing EHR in pathology labs. 5. The disturbance in the pathology lab workflow is a significant challenge due to the implementation of the EHR system. The incomplete guidance on using EHR in laboratory work practices creates problems in the smooth functioning of the entire lab system. The need for proper instruction about the functioning of EHR in pathology labs disturbs the workflow of labs. By developing adequate coordination with EHR training specialists, it becomes easy to understand the function of EHR in the routine practices of the pathology lab. 6. Another big challenge faced during the EHR setup in labs is privacy concerns. Some patients express concern that their personal information might be leaked due to the use of EHRs. In most cases, patient data is hacked due to a poor security system. To ensure that patient data is safe and secure, it is crucial to develop a fully secure Electronic Health Record (EHR) system. The authorities that implement EHR are responsible for the security of patient personal data. It's essential to establish a fully secure and safe electronic data storage system. To address the challenges related to patient privacy concerns, the most prominent challenge faced by health staff regarding EHR implementation is transforming data from a logistical form to a digitalised form. The data entry process is very tedious for medical staff as patients' data is in bulk. To overcome this challenge, only the data necessary for patients' future treatment is transferred into digitalized form, while the rest of the data is discarded.

Opportunities Associated with EHR Implementation

EHRs provide great opportunities in the healthcare field. these opportunities are discussed below; 1. The first opportunity EHR provides in the healthcare sector is to maintain a well-structured and sequenced health record of the patient based on their health condition. the structured health data related to the patient helps in treating the patient more effectively. The patient's complete health history, from the onset of their disease, is documented in the EHR. this information is crucial in understanding the complexity of a patient's disease. 2. For monitoring the health system, the EHR serves as a Decision Support System (DSS). The DSS is an automated system that assists the pathologist in the decision-making process. The data analysis of the quality of DSS makes it suitable for analysing patient data and drawing the required conclusions from it. the quality of data stored and monitored using DSS software is error-free. 3. The process of documenting patient information is done using reliable technology-based systems. This accurate system is an EHR that aims to provide the most precise data documentation. Data documentation is essential as it helps in the medical billing process. Moreover, maintaining data integrity and data quality is the primary function of an EHR. the EHR is a database of all the patient's data. Any information related to a patient's medical condition is found easily in the EHR. 4. Different pathology labs around the world can easily assess the data stored in EHR. EHR is an electronic form of data, and accessing this data through various sources is a relatively easy task. pathologists from multiple disciplines can easily access the data from anywhere in the world. to provide health services in remote areas physicians use the services of EHR. health organizations work by enhancing the quality of health services they provide with the help of EHR. 5. The quality of data obtained from EHR is more accurate and error-free. The chances

of data corruption are low due to the high security of EHR systems. The EHR is specifically designed to ensure the safety and security of medical records. The entire data stored in the EHR is easily analysed by an intelligence-based system implemented in the EHR's workflow. The intelligence-based system minimises the error probability in data. 6. In addition to the primary benefits and opportunities of EHR, this system is also recognised for its secondary benefits. the secondary benefit of EHR is that it is used for medical and clinical research purposes. The work related to research on different diseases is accelerated by the application of EHR in pathology-based research labs. Moreover, pathologists prefer to use data sources from EHR to maintain the integrity of their research programs. Most health-based research programs are conducted in pathology labs using EHR software to obtain the most authentic data from patient personal health records.

Conclusion

Previously, a patient's examination depended on the communication between the doctor and the patient. Currently, hospital collects information using electronic health records. This method is used in many clinics and hospitals, and its use increased from 8% in 2009 to 96% in 2015. Doctors' workflow with patient data has been changed with the help of these tools. The team must collect

the same type of information. For this purpose, spectators used templates on which certain kinds of questions were recorded that should be asked of patients. The data recorded includes patient information, reports, details, age, gender, progress reports, discharge details, and much other information. Most of the patient's data is collected during afternoon sessions, as many patient healthcare accomplishments occur in the afternoon. Unstructured information can also be collected at this time, and interaction levels increase in the afternoon. The activity flow of the patient record from afternoon observations depends on the number of patients reported to be managed by team members. In pathology, data are recorded in electronic health records; in pathology data sets, one cell represents a pathology section. Patient and pathologist names and identification records were recorded in separate columns. If the one pathology report represented two different specimens, it was converted into two reports. The two reports were represented with one or more line breaks so that the pathologist could understand the numerous texts in individual reports. The pathology report also included an additional description for further information, which was not included in the keywords. Pathology reports also utilised strict keywords for data extraction. Moreover, the uppercase letters were changed to lowercase letters, and special characters were also removed.

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