Nahala Ahammed
Research Scholar, Banasthali
Vidyapith, Rajasthan, India

Dr. Nishtha Pareek
Associate Professor,
Banasthali Vidyapith,
Rajasthan, India

Dr. Vimlesh Tanwar
Assistant Registrar,
Banasthali Vidyapith,
Rajasthan, India

Examining the implementation challenges and benefits of electronic health records (EHR) systems in large hospital settings

Nahala Ahammed, Dr. Nishtha Pareek and Dr. Vimlesh Tanwar

DOI: https://doi.org/10.33545/27068919.2024.v6.i1a.1153

Abstract
This study investigates the implementation challenges and benefits of electronic health records (EHR) systems in large hospital settings. The adoption of EHR systems promises to revolutionize healthcare delivery by improving the efficiency and accuracy of patient data management and enabling better clinical decision-making. However, large hospitals face unique challenges in integrating these complex systems into their existing infrastructures.

Keywords: Implementation challenges, benefits of electronic health, (EHR) systems, large hospital settings

Introductions

An electronic health record (EHR) is a digital replica of a patient's chart that the doctor or other healthcare professional maintains current. It may include all the vital statistics, demographic information, medications, problems, vital signs, immunisations, test findings, and radiological reports that are relevant to a patient's treatment under a particular provider. By automating information access, the EHR has the potential to improve physician workflow. Quality monitoring, results reporting, and evidence-based decision assistance are just a few of the many care-related duties that the EHR might assist with via its many interfaces. It is possible that electronic health records (EHRs), the next innovation in healthcare, may help physicians and patients get along better. The timely availability of the data will allow clinicians to make better choices and deliver better treatment. (Guo *et al*., 2018) [4] (Shickel *et al*., 2017) [13]

The Indian Ministry of Health and Family Welfare (MoH&FW) released the country's EHR standards in September 2013. While deciding which standards to add, we looked at the most popular and effective ones for EHRs throughout the world and how well they would function in India. Members of the corporate community, government officials, technologists, and practitioners formed the committee to propose the standards. Several stakeholders, professional groups, government organisations, and specialists in both technological and social fields praised the newly stated criteria. Moving ahead with the adoption was the next step for MoH &FW. While standards like SNOMED CT have been freely available for use in the country for the past two years, the Ministry has appointed an interim National Release Centre (NRC) to manage this clinical terminology standard, which is rapidly gaining acceptance among the various healthcare IT stakeholder communities worldwide.

However, this Act mandates that clinicians use EHRs in a "meaningful" manner, which involves using certain EHR functions linked to cost savings and mistake reduction, since a basic EHR system only partially benefits patients and society. What particular ways are patient care improved by electronic health records? Is there any evidence, moreover, that using any EHR "meaningful use" features would be advantageous as of yet? To address these questions is the aim of this research. (Nguyen *et al*., 2019) [9] Evaluating the impact of EHR research is the particular aim of this study. We examine the pros and negatives that experts and researchers have found, since effects may have both positive and negative outcomes. After considering all the factors, our objective is that this research would be helpful to readers who are curious about the present level of evidence about the advantages of EHRs. (Rostamzadeh *et al*., 2020) [10].

Corresponding Author:
Nahala Ahammed
Research Scholar, Banasthali
Vidyapith, Rajasthan, India

Any data set that documents a patient's health over time as a result of one or more interactions with a healthcare provider, regardless of setting, is known as an electronic health record (EHR). Test results, patient demographics, medicines, vital signs, progress notes, issues, immunisation history, as well as radiological examinations are all part of this data set. The two main advantages of EHRs are the simplification of data access and the removal of sloppy handwriting from medical records. (Harerimana *et al.*, 2019) [5] Clinical decision support (CDS) tools, computerised physician order entry (CPOE) systems, as well as wellness information exchange (HIE) are three use cases for electronic health record (EHR) systems that have the most promise for enhancing treatment quality while simultaneously lowering costs. (Seol *et al.*, 2018) [12]

Decisions about patient care may be aided by a CDS system. A CDS system may provide up-todate pharmaceutical information, cross-reference a patient's medication allergies, and even warn users to possible drug interactions as well as additional problems the computer detects with the patient. All of these factors contribute to more secure and efficient medication administration as a result of the ever-expanding body of medical knowledge. With the use of more and more CDS systems, the patient will often get safer and more effective care. Additionally, it is expected that certain medical errors will be avoided. (Sun & Zhang, 2019) [14]

Instead of writing out orders for items like pharmaceuticals, lab work, radiography, and physical therapy, healthcare practitioners may enter them into computers using CPOE systems. This process is being computerised to avoid potentially dangerous medical errors caused by careless handwriting by physicians. (Alzahrani *et al.*, 2022) [1] It also expedites the ordering process by eliminating the need for pharmacy and nursing staff to contact incomplete or illegible orders to ask for clarification or missing information. Previous studies have shown that the implementation of a CPOE system by itself may reduce severe medication errors by as much as 55%. When paired with a CDS system that issues warnings in response to doctor instructions, the decrease can increase to 83%. When a CPOE system is integrated with a CDS, it may result in improved care effectiveness and efficiency. (Tang *et al.*, 2019) [15]

EHRs facilitate the electronic exchange of patient data via HIE by giving doctors access to health information. A technique called Health Information Exchange (HIE) enables several entities to exchange electronic health data at the patient level. It may significantly increase the effectiveness of healthcare delivery. Health information exchange (HIE) has the ability to decrease the number of unnecessary and expensive tests done when one doctor doesn't have access to clinical data kept by another doctor since it allows for the safe and perhaps immediate transfer of patient information. The patient's personal information is frequently saved at each of the several facilities where they get treatment. Among these places can be a pharmacy or pharmacies, the office of the primary care physician, the offices of various medical specialists, and even emergency rooms and hospitals. A lifetime's data is gathered at several locations, and each one is stored in its own silo. Since providers have traditionally relied on mailing or faxing important documents to one other, it has been challenging to

obtain them in "real time" at the correct moment. Healthcare information exchange (HIE) makes it easier for EHRs to share this data, which could lead to cheaper and better treatment. (De Benedictis *et al.*, 2020, Salleh *et al.*, 2021) [3, 11]

We summarise the research that has looked at how EHRs have affected different kinds of clinical and organisational outcomes below. In Section 3 detailing the research approach for investigating EHR implementation challenges and benefits. In section 4 presents empirical findings and discussing their implications for large hospital settings. Section 5 summarizes key insights and providing recommendations for maximizing EHR effectiveness.

Literature Review
(Bisrat *et al.*, 2021) [2] The purpose of this research was to evaluate the existing state of affairs, pinpoint obstacles, success variables, and the perspective of medical experts towards the system in order to provide suggestions for next implementations and expansion strategies. The research used a cross-sectional strategy and included both quantitative and qualitative methodologies. To ensure a sustainable adoption of electronic medical record systems, it is important to evaluate the hospital's preparedness, choose and acquire approved systems, meet logistical needs with sufficient supplies and equipment, and upgrade the hospital's information and communication technology infrastructure.

(Ngusie *et al.*, 2022) [8] This study suggests that a significant amount of work has to be done to enhance readiness before EHRs are actually implemented. The results showed that younger age groups were better suited to employ this kind of technology, suggesting that older age groups should be treated with more care. In order to make this environment more EHR ready, we needed to do things like raise computer literacy, boost self-efficacy with this technology, fix the issue of health facilities not having enough computers, encourage a positive outlook, spread the word about how important EHRs are, and recognise their importance.

(Jung *et al.*, 2021) [7] This research aims to comprehend the perceived barriers, facilitators, and fundamental concepts driving the adoption and use of an electronic health record (EHR) for mental health services by looking at the experiences of mental health practitioners. Using a content analysis, four facilitators and seven impediments were identified. Nurses' inexperience with computers, the system's complexity, alert fatigue, and resistance from previous systems were the primary hurdles to the implementation of the electronic health record system for mental health treatment. This led to a lack of confidence in the system and its limited acceptance and value.

(Hertzum *et al.*, 2022) [6] Document analysis forms the work's foundation. Research papers, evaluation reports, materials from project partners, and user surveys are among the items that have been reviewed. Neither of the two implementations' post-implementation experiences lived up to the expectations set before the implementation. Actually, the impact of using Epic was not readily apparent prior to go-live. Consequently, most adopting businesses and their users have been more reactive, trying to ward off problems rather than proactive, in their pursuit of benefits.

(Salleh *et al.*, 2021) [11] showed that system compatibility was the most crucial component of system quality, and that knowledge quality had the largest effect size and best performance prediction score. The results demonstrated that greater information enhanced user performance and that EHR systems enhanced system quality by supporting healthcare practitioners in their clinical duties and processes.

(De Benedictis *et al.*, 2020) [3] This research incorporates institutional and human components to explore the variables managers may use to influence professional conduct and which factors might either encourage or hamper hospitals' adoption of electronic medical records (EMRs). A survey that was given to doctors and nurses at a university hospital in Rome, Italy, was used to gather data. There were 114 excellent replies in all. The findings indicate that there will be many advantages for doctors and nurses who use EMRs. EMRs are specifically designed to support provider-to-provider interaction, education, research, and quality improvement; they should also provide you more control over your own practice and improve service quality, effectiveness, and efficiency.

Methodology
Aim
To investigate the hurdles faced during the application of EHR systems in large hospital settings and assess the associated benefits.

Objectives
1. To identify the key challenges faced during the implementation of Electronic Health Records (EHR) systems in large hospital settings.
2. To assess the benefits perceived from the adoption of EHR systems in large hospital settings.
3. To examine the security and privacy concerns associated with the use of EHR systems in large hospital environments.

Hypotheses
1. Implementing EHR systems in large hospitals will face challenges related to technology, organization, and culture.
2. The perceived benefits of adopting EHR systems in large hospitals, including improvements in patient care, efficiency, and decision-making, will be moderated by the level of staff training.
3. The implementation of EHR systems in large hospital environments will result in heightened security and privacy concerns among healthcare professionals and patients alike, with factors such as data breaches, unauthorized access, and compliance issues contributing to these concerns.

Research Design
This study adopts a quantitative research design to examine the implementation challenges and benefits of Electronic Health Records (EHR) systems in large hospital settings.

Sampling Technique
The study population comprises healthcare professionals, including doctors, nurses, and administrative staff, working in large hospital settings where EHR systems are implemented. Participants with prior knowledge of EHR systems will be recruited using a purposive sampling strategy. The sample size is determined to be 363 participants to ensure adequate representation and statistical power.

Data Collection
Data will be collected using a structured questionnaire designed to capture information on both the challenges and benefits associated with EHR system implementation. Demographics, EHR system utilisation, perceived obstacles, and perceived advantages are all included in the questionnaire. Depending on participant choices and accessibility, both online and paper-based questionnaires will be used for data collection. Participants will get guarantees about the privacy and anonymity of their answers.

Data Analysis
Statistical software tools, such as AMOS (Analysis of Moment Structures) and SPSS (Statistical Package for the Social Sciences), will be used to analyse the gathered data. The demographic details of the participants and the frequency of survey question answers will be summed together using descriptive statistics.The suggested theoretical model will be tested and the correlations between the variables will be examined using structural equation modelling, or SEM, analysis. To evaluate the direct and indirect impacts of difficulties with the adoption of the EHR system on perceived advantages, SEM analysis using AMOS software will be used.

Ethical Considerations
- Ethical approval from the relevant ethics committee or institutional review board (IRB) will be obtained before data collection begins.
- Prior to their involvement in the research, each subject will provide their informed permission.
- The freedom to withdraw from the study at any time will be communicated to participants.
- Throughout the study procedure, precautions will be taken to guarantee participant data privacy and confidentiality.

Results and Analysis
Hypothesis 1: Implementing EHR systems in large hospitals will face challenges related to technology, organization, and culture.
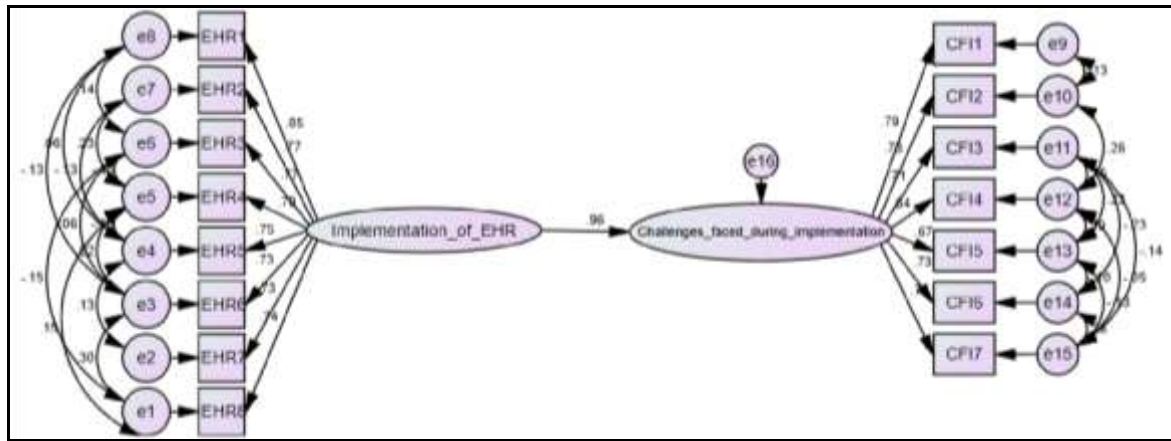
Fig 1: Implementing EHR systems in large hospitals will face challenges related to technology, organization, and culture

Table 1: Regression Weights: (Group number 1 - Default model)

		PATH	Un Standardized Coefficient	S.E.	Standardized Coefficient	C.R.	P
Challenges faced during implementation	<---	Implementation of EHR	1.044	.070	.960	14.9 46	***
IEHR8	<---	Implementation of EHR	1.000		.745		
IEHR7	<---	Implementation of EHR	.944	.066	.726	14.297	***
IEHR6	<---	Implementation of EHR	.990	.058	.731	17.171	***
IEHR5	<---	Implementation of EHR	1.089	.075	.747	14.557	***
IEHR4	<---	Implementation of EHR	.960	.065	.701	14.840	***
IEHR3	<---	Implementation of EHR	1.118	.079	.767	14.150	***
IEHR2	<---	Implementation of EHR	1.129	.074	.770	15.255	***
IEHR1	<---	Implementation of EHR	1.445	.085	.851	16.942	***
CFI1	<---	Challenges faced during implementation	1.000		.786		
CFI2	<---	Challenges faced during implementation	.924	.064	.730	14.345	***
CFI3	<---	Challenges faced during implementation	.916	.063	.712	14.544	***
CFI4	<---	Challenges faced during implementation	.787	.061	.642	12.875	***
CFI5	<---	Challenges faced during implementation	.813	.060	.667	13.455	***
CFI6	<---	Challenges faced during implementation	1.127	.075	.731	15.045	***
CFI7	<---	Challenges faced during implementation	.886	.056	.765	15.902	***

The theoretical structural equation model in the table shows how Implementation of EHR and Challenges faced during implementation are related. The study found a substantial positive correlation ($\beta=0.960$, $p<0.05$) between women empowerment and microfinance interventions. The standardized coefficient of 0.960 suggests a positive relationship between Implementation of HER and Challenges faced during implementation knowledge. The link is statistically significant, as evidenced by high C.R. values. Fit indices reveal a good model fit, with seven criteria indicating a positive and significant relationship between women's empowerment and microfinance programs.

Table 2: Model Fit Summary

Variables	Value
CFI	0.973
Chi-square value ($\chi2$)	82.670
CMIN/DF	2.851
Degrees of freedom (df)	29
GFI	0.959
IFI	0.974
NFI	0.960
P value	0.000
RFI	0.938
RMR	0.031
RMSEA	0.070

The quality of fit for the sample's data was assessed using various indices. The $\chi2$ value was 82.670, indicating an adequate illustration. Additionally, the IFI (0.974), NFI (0.960), GFI (0.959), RFI (0.938), and CFI (0.973) all exceeded the threshold of 0.90, further confirming the high quality of fit. Additionally, it is worth noting that the values of RMSEA= 0.070 and RMR= 0.031 fall below the established threshold value of 0.080. The model that was used in the analysis included the following fit indices: RMSEA, RMR, GFI, and CFI. The results indicated that the model had a good fit.

Hypothesis 2: The perceived benefits of adopting EHR systems in large hospitals, including improvements in patient care, efficiency, and decision-making, will be moderated by the level of staff training.
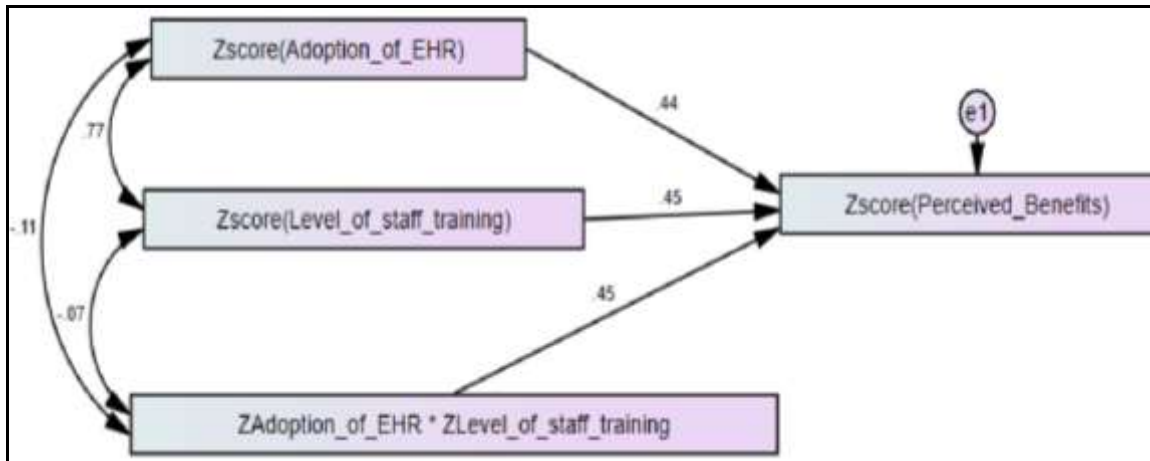
Fig 2: The perceived benefits of adopting EHR systems in large hospitals, including improvements in patient care, efficiency, and decision-making, will be moderated by the level of staff training

Table 3: Regression Weights: (Group number 1 - Default model)

		Path	Un Standardized Coefficient	S.E.	Standardized Coefficient	C.R.	P
Z Perceived Benefits	<---	Z Adoption of EHR	.502	.03 9	.437	12.96 2	***
Z Perceived Benefits	<---	Z Level of staff training	.514	.03 9	.448	13.32 3	***
Z Perceived Benefits	<---	Z Adoption of EHR* Z Level of staff training	.099	.00 5	.450	20.73 7	***

The Structural Equation Model (SEM) examining the association between Z score (Z Adoption of EHR) and Z score (Z Perceived Benefits) with moderation by level of Training is presented in Table3. This comprehensive analysis allows for testing all relevant paths, considering measurement errors and feedback directly within the model. Hypothesis resulting based on path analysis shows that Z score (Z Adoption of EHR) is positively and significantly associated with Z score (Z Perceived Benefits) (β=.502, $p<0.05$).

Z Level of staff training is positively and significantly associated with Z score (Perceived Benefits) (β=.448, $p<0.05$).

Moderation Testing

The moderation analysis is conducted by treating Z score (Adoption of EHR) as independent variables, Z score (Perceived Benefits) as dependent variable, and Z Level of staff training variables as moderator variable. Using SPSS, interaction terms are created using the standardised scores of the variables to compute the results.

|		Path	Un Standardized Coefficient	S.E.	Standardized Coefficient	C.R.	P
Z Perceived Benefits	<---	Z Adoption of EHR* Z Level of staff training	.099	.00 5	.450	20.73 7	***
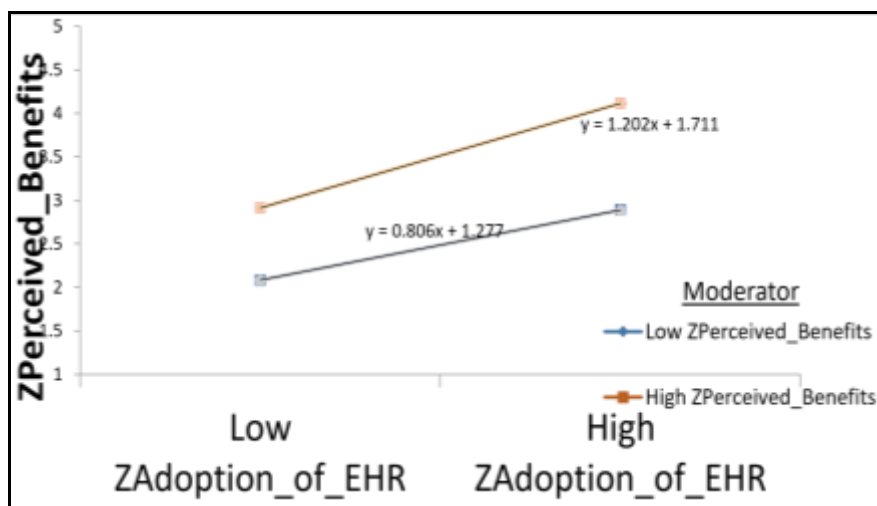
Fig 3: Z Perceived Benefits

Table 4: Model Fit Summary

Variables	Value
CFI	0.973
Chi-square value (χ2)	82.670
CMIN/DF	2.851
Degrees of freedom (df)	29
GFI	0.959
IFI	0.974
NFI	0.960
P value	0.064
RFI	0.938
RMR	0.031
RMSEA	0.070

The quality of fit for the sample's data was assessed using various indices. The χ2 value was 82.670, indicating an adequate illustration. Additionally, the IFI (0.974), NFI (0.960), GFI (0.959), RFI (0.938), and CFI (0.973) all exceeded the threshold of 0.90, further confirming the high quality of fit. Additionally, it is worth noting that the values of RMSEA= 0.070 and RMR= 0.031 fall below the established threshold value of 0.080. The model that was used in the analysis included the following fit indices: RMSEA, RMR, GFI, and CFI. The results indicated that the model had a good fit.

Hypothesis 3: The implementation of EHR systems in large hospital environments will result in heightened security and privacy concerns among healthcare professionals and patients alike, with factors such as data breaches, unauthorized access, and compliance issues contributing to these concerns.
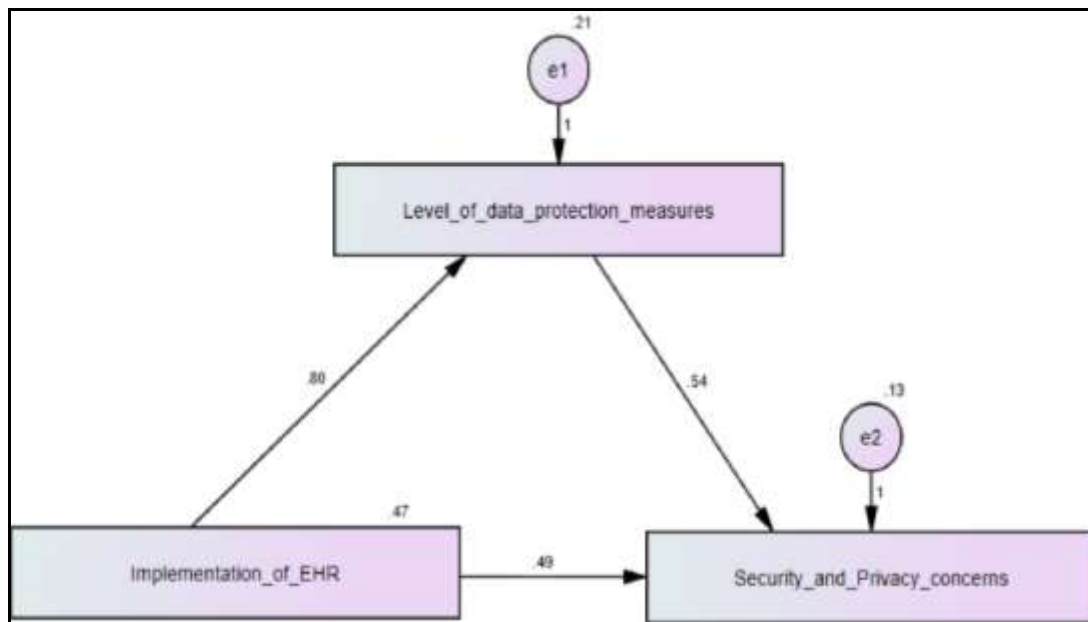
Fig 4: The implementation of EHR systems in large hospital environments will result in heightened security and privacy concerns among healthcare professionals and patients alike, with factors such as data breaches, unauthorized access, and compliance issues contributing to these concerns

Table 5: Regression Weights: (Group number 1 - Default model)

Path			Unstained Rdized Coefficient	S.E.	Standard i Zed Coefficient	C.R.	P
Level of data protection measures	<---	Implementation of _EHR	.802	.034	.767	23.394	***
Security and Privacy concerns	<---	Implementation of _EHR	.494	.043	.436	11.632	***
Security and Privacy concerns	<---	Level of data protection measures	.544	.041	.502	13.395	***

The table presents the results of a path analysis examining the relationships Implementation of EHR and Security and Privacy concerns, and Level of data protection measures among individuals in the study. The path from Convenience and Implementation of EHR to Security and Privacy concerns shows a strong positive association (β = 0.767, p<0.05).

Table 6: Standardized Indirect Effects (Group number 1 - Default model)

	Implementation of EHR	Level of data protection measures
Level of data protection measures	.000	.000
Security and Privacy concerns	.437	.000

Table 4 presents standardized indirect effects from the default model for Group number 1, examining the relationship between the implementation of Electronic Health Record (EHR) systems, the level of data protection measures, and security and privacy concerns in large hospital settings. The dependent variable in this table is security and privacy concerns, whereas the independent factors are the degree of data protection and the deployment of EHR systems. The coefficients in the table show the indirect impacts between variables. According to the

investigation, the degree of data protection measures has a strong indirect impact (Coefficient = 0.437) of the EHR system installation on security and privacy issues. Regarding security and privacy issues when it comes to the deployment of EHR systems, there is, however, no appreciable indirect impact of the degree of data protection measures. This suggests that the implementation of EHR systems indirectly influences security and privacy concerns through its impact on the level of data protection measures, emphasizing the importance of robust security measures in mitigating privacy concerns associated with EHR systems in large hospital environments.

Table 7: Model Fit Summary

Variables	Value
CFI	0.974
Chi-square value ($\chi2$)	70.003
CMIN/DF	2.059
Degrees of freedom (df)	34
GFI	0.963
IFI	0.974
NFI	0.951
P value	0.061
RFI	0.935
RMR	0.031
RMSEA	0.053

The quality of fit for the sample's data was assessed using various indices. The $\chi2$ value was 70.003, indicating an adequate illustration. Additionally, the IFI (0.974), NFI (0.951), GFI (0.963), RFI (0.928), and CFI (0.962) all exceeded the threshold of 0.90, further confirming the high quality of fit. Additionally, it is worth noting that the values of RMSEA= 0.053 and RMR= 0.031 fall below the established threshold value of 0.080. The model that was used in the analysis included the following fit indices: RMSEA, RMR, GFI, and CFI. The results indicated that the model had a good fit.

Conclusion
The implementation of Electronic Health Records (EHR) systems in large hospital settings presents both challenges and benefits that warrant careful consideration. Throughout this examination, it has become evident that while the adoption of EHR systems promises significant advantages such as improved efficiency, enhanced patient care, and better coordination among healthcare providers, it is not without its obstacles. The challenges identified range from initial financial investments and technical complexities to resistance from healthcare professionals and concerns regarding data security and privacy. However, addressing these challenges through comprehensive training programs, robust cybersecurity measures, and effective change management strategies can mitigate risks and facilitate successful implementation. Moreover, the benefits of EHR systems cannot be understated. They have the potential to revolutionize healthcare delivery by streamlining workflows, reducing errors, facilitating evidence-based decision-making, and empowering patients to actively participate in their own care. Furthermore, the integration of advanced technologies like artificial intelligence and predictive analytics holds promise for further enhancing the capabilities of EHR systems.
In essence, while the road to implementing EHR systems in large hospital settings may be fraught with challenges, the rewards are undoubtedly worth the effort. By addressing implementation hurdles proactively and leveraging the full potential of EHR systems, healthcare organizations can pave the way for improved patient outcomes, increased efficiency, and ultimately, a more sustainable healthcare ecosystem.

References
1. Alzahrani S, Daim T, Choo K-KR. Assessment of the blockchain technology adoption for the management of the electronic health record systems. IEEE Trans Eng Manage. 2022.
2. Bisrat A, Minda D, Assamnew B, Abebe B, Abegaz T. Implementation challenges and perception of care providers on Electronic Medical Records at St. Paul's and Ayder Hospitals, Ethiopia. BMC Med Inform Decis Mak. 2021;21(1):1-12.
3. De Benedictis A, Lettieri E, Gastaldi L, Masella C, Urgu A, Tartaglini D. Electronic Medical Records implementation in hospital: An empirical investigation of individual and organizational determinants. PloS One. 2020;15(6):e0234108.
4. Guo R, Shi H, Zhao Q, Zheng D. Secure attribute-based signature scheme with multiple authorities for blockchain in electronic health records systems. IEEE Access. 2018;6:11676-11686.
5. Harerimana G, Kim JW, Yoo H, Jang B. Deep learning for electronic health records analytics. IEEE Access. 2019;7:101245-101259.
6. Hertzum M, Ellingsen G, Cajander Å. Implementing large-scale electronic health records: experiences from implementations of epic in Denmark and finland. Int J Med Inform. 2022;167:104868.
7. Jung SY, Hwang H, Lee K, Lee D, Yoo S, Lim K, Lee H-Y, Kim E. User perspectives on barriers and facilitators to the implementation of electronic health records in behavioral hospitals: qualitative study. JMIR Form Res. 2021;5(4):e18764.
8. Ngusie HS, Kassie SY, Chereka AA, Enyew EB. Healthcare providers' readiness for electronic health record adoption: A cross-sectional study during preimplementation phase. BMC Health Serv Res. 2022;22(1):1-12.
9. Nguyen DC, Pathirana PN, Ding M, Seneviratne A. Blockchain for secure ehrs sharing of mobile cloud based e-health systems. IEEE Access. 2019;7:66792-66806.
10. Rostamzadeh N, Abdullah SS, Sedig K. Data-driven activities involving electronic health records: an activity and task analysis framework for interactive visualization tools. Multimodal Technol Interact. 2020;4(1):7.
11. Salleh MIM, Abdullah R, Zakaria N. Evaluating the effects of electronic health records system adoption on the performance of Malaysian health care providers. BMC Med Inform Decis Mak. 2021;21(1):1-13.
12. Seol K, Kim Y-G, Lee E, Seo Y-D, Baik D-K. Privacy-preserving attributebased access control model for XML-based electronic health record system. IEEE Access. 2018;6:9114-9128.
13. Shickel B, Tighe PJ, Bihorac A, Rashidi P. Deep EHR: a survey of recent advances in deep learning techniques

for electronic health record (EHR) analysis. IEEE J Biomed Health Inform. 2017;22(5):1589-1604.

14. Sun Y, Zhang D. Diagnosis and analysis of diabetic retinopathy based on electronic health records. IEEE Access. 2019;7:86115-86120.

15. Tang F, Ma S, Xiang Y, Lin C. An efficient authentication scheme for blockchainbased electronic health records. IEEE Access. 2019;7:41678-41689.