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Enhancing electronic health record integration in large hospital environments: Addressing challenges, training, and cultivating organizational awareness

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Abstract
The present study examines the various determinants that impact the implementation and utilisation of Electronic Health Record (EHR) systems in large hospital environments. Specifically, it investigates the challenges associated with system integration, the efficacy of training programmes, the competency of staff, and organisational cognizance. Through a quantitative research design, surveys were conducted to gather data from 384 participants aged 18 to 45 in both public and private hospital settings. Utilising Structural Equation Modelling (SEM), an analysis of the data unveiled noteworthy connections between variables. According to the findings, overcoming implementation challenges is crucial for enhancing EHR integration effectiveness, highlighting the significance of addressing obstacles early on. Furthermore, by investing in training programmes, you can improve staff competence and the perceived benefits of EHR adoption, underscoring the importance of continuous training for healthcare workers. In addition, having a strong organisational awareness greatly impacts the success of EHR implementation, highlighting the need to promote a culture of awareness and involve stakeholders. This research offers valuable insights into the intricacies of EHR integration in large hospital settings and proposes comprehensive strategies to enhance healthcare delivery and patient outcomes.

Keywords: Electronic health records, EHR integration, implementation challenges, training programmes, staff competency, organisational awareness, and structural equation modelling (SEM)

1. Introduction
The change from paper-based to electronic health records began in the early 1990s, driven by technological advancements and support from the Institute of Medicine in the US [1]. Electronic health records have continued to be created and envisioned with numerous anticipated advantages throughout the course of the previous 25 years. This is due to the fact that the shortcomings of paper-based health records have progressively been apparent to the healthcare sector [2]. While the fundamental notion behind electronic records has stayed the same over the course of those twenty-five years, the names and phrases that are used to express the concept of electronic records have undergone regular changes. At this point in time, the phrase "electronic health record" (EHR) is often used to refer to records that are used by physicians [3]. This use, on the other hand, does not conform to the manner in which the International Organisation for Standardisation (ISO) has defined the various categories of electronic documents. In accordance with the International Organisation for Standardisation (ISO) 14639-1:2012(en), the term "electronic medical record" (EMR) is defined as "an electronic record of an individual in a physician's office or clinic, which is typically in one setting and is provider-centric." On the other hand, the term "electronic patient record" (EPR) is defined as "an electronic record of an individual in a hospital or health care facility, which is typically in one organisation and is facility-centric." In many countries, however, there is a continuum that exists between the two stringent interpretations of the electronic health record (EHR) and the personal health record (PHR) on the one hand, respecting the entity that has authority over the record and the material that is included within it, and the tethered PHRs on the other side [4]. The latter scenario involves the care provider providing the patient with access to the electronic health record (EHR) without the patient having any control over it.

The access feature is often included as a component of a patient portal. Around twenty-five years following the introduction of electronic health records (EHRs), significant advancements have been achieved in terms of the deployment, acceptance, and utilisation of EHRs. To our regret, the majority of this has been done in a manner that is not coordinated, rather than using an approach that is coordinated and rational. In terms of time efficiency, productivity, and enhanced quality of treatment, many of the early promises have not been reached or have only been partly realised. Furthermore, "current electronic health records still do not meet the needs of today's rapidly changing healthcare environment" [2]. Data duplication is still a prevalent problem, and solutions are continuously being sought, despite the fact that it was anticipated that the adoption of electronic health records would alleviate this problem [5]. Only in recent times has there been any major progress made in the building of legislative frameworks for patient privacy and confidentiality in relation to electronic health record data. The capacity of data interchange, the secondary use of data, and decision assistance has been increased as a result of ongoing development on information standards for electronic health record (EHR) data. The realisation of advantages is still behind expectations, despite the fact that there seems to be progress in the techniques of deployment and the use of electronic health records (EHRs). The fact that doctors, who are the end users of electronic health records (EHRs), face significant hurdles severely limits the ability of EHRs to enhance the work of clinicians and to improve the quality of treatment provided to patients. There is still a lot of debate on whether or not the use of electronic health records (EHRs) increases efficiency (often known as "saves time") for physicians [2]. There are others who feel that the use of electronic health records has resulted in an improvement in patient care; nonetheless, further work has to be done. More specifically, in order to arrive at a conclusion that is more definite, it is necessary to identify the intricate mechanism that is responsible for the assessment of patient outcomes in relation to the installation of electronic health records [6].

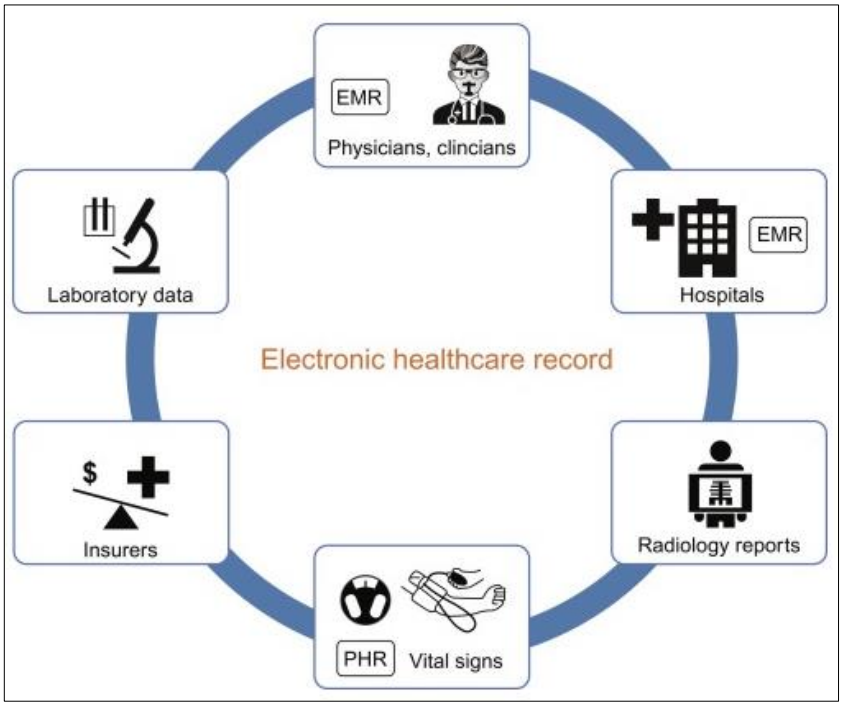


Fig 1: Image of EHR System

When it came to the EHR Incentive Programme, hospitals that were participating in the Medicare section risked financial penalties in 2015 if they did not satisfy the standards:

1. This "carrot-and-stick" method was developed with the intention of addressing the most significant obstacle that is preventing the widespread use of electronic health records (EHR), which is the large financial cost.
2. The aim was that with widespread adoption and usage, improvements would be observed in the quality and efficiency of treatment that is provided.
3. Since the introduction of these incentives, the percentage of hospitals that have adopted electronic health records (EHR) has significantly grown, and in 2013, it surpassed fifty percent for the first time [7].

Although reaching the point where the majority of hospitals have adopted electronic health records (EHR) is a significant achievement, it is of the utmost importance to go as near as possible to obtaining national acceptance of these systems in order to reap the advantages of EHR adoption on the network. As a result of the fact that the "early majority" has already gone through with the adoption, the remaining hospitals could be the ones that face the most difficulties and are thus the least likely to participate [8]. In the event that this possible levelling off of adoption occurs, it would be detrimental to the objectives of establishing a genuine national health information infrastructure [9]. As a result, there is a strong desire to continue to keep a close eye on the use of electronic health records (EHR) and to make adjustments to policies as required. Hospitals that are small and rural, which have adoption rates that are consistently lower, are important groups to keep an eye on. Furthermore, the success of the federal policy endeavour is contingent on the degree to which hospitals are able to use their electronic

health records (EHRs) in order to fulfil the requirements for meaningful use. The year 2014 was the first year in which hospitals started attesting to the second stage of meaningful use. Meaningful use in Stage 2 goes beyond the simple gathering of structured data and focuses on more complex applications of electronic health records (EHRs). The data from 2013 indicate that 94.2% of hospitals were not prepared to satisfy the goals of stage 2, and that the subset of criteria relating to the interchange of electronic health information with patients and other providers was often the element that acted as a limiting factor. 2014 was the year when not all hospitals were obliged to testify to stage 2, but in 2015, the majority of hospitals were compelled to do so. As a result, it is of the utmost importance to evaluate the progress that has been made in these areas and to identify the obstacles that persons who are striving to proceed through the phases of the meaningful-use programme encounter.

1.1 EHR in India

In September of 2013, the Ministry of Health and Family Welfare (MoH&FW) issued a notification on the Electronic Health Record (EHR) Standards for India. The collection of standards that are presented therein were selected from the most effective and widely used standards that are relevant to electronic health records from all around the globe, with consideration given to how well they fit the requirements of India and how well they may be used there. Experts, practitioners, government officials, technicians, and representatives from industry were all members of the committee that was established to provide recommendations on the standards. Not only did the announced standards get support from professional groups, regulatory authorities, and stakeholders, but they also received support from a variety of technical and social critics who saw them as a step in the right direction. As the next step, the Ministry of Health and Family Welfare moved forward with the process of facilitating the adoption. Over the course of the past two years, the Ministry has made existing standards, such as SNOMED CT, available for free use within the country [10]. Additionally, the Ministry has appointed an interim National Release Centre (NRC) to manage this clinical terminology standard, which is rapidly gaining widespread acceptance among the various healthcare IT stakeholder communities around the world. During the notification of the standards in September 2013, it was known that the standards themselves would continue to develop over the course of time. Consequently, it was agreed upon that this notice would, at some point in the future, call for amendment. As the awareness of those standards, their execution, and the expectations from the healthcare systems continue to develop, this becomes an even more important need. As a result, the Ministry of Health and Family Welfare established a panel of specialists to examine the previously announced set of criteria, taking into consideration both the past and the outlook for the future. The recommendations that were reached by the Expert Committee after discussing on the many issues of standardisations in healthcare record systems are represented by the set of standards that is supplied in this document. A thorough examination of the provisions of open standards and the guidelines in accordance with the rules established by MeitY, the Government of India, was also carried out by the Committee, which then made recommendations on the standards that were presented later in the paper.

1.2 Need for electronic health record

In order for a health record of a person to have any clinical significance, it must, at the absolute least, begin beginning at the moment of conception or birth. Each and every record of each and every clinical interaction that a person has throughout their life reflects a health-related event that has occurred in that person's life. In light of the present issues that the individual is dealing with, each of these records can be either trivial or crucial, depending on the circumstances. Therefore, it is of the utmost importance that these data be accessible, that they be organised in a longitudinal fashion as a time series, and that they be clinically relevant in order to offer a summary of the different healthcare events that occur over the life of an individual. A collection of different medical documents that are created during each clinical interaction or event is referred to as an electronic health record, or EHR for short. The proliferation of self-care and homecare devices and systems has resulted in the generation of real-time, useful healthcare data that not only has long-term clinical importance but also is created around the clock. It is important to collect as many medical records as possible for a variety of reasons, including but not limited to the following: better and more evidence-based care; an increasingly accurate and faster diagnosis that results in better treatment at lower costs of care; the avoidance of unnecessary investigations; robust analytics, including predictive analytics, to support personalised care; and improved health judgements about public policy that are founded on a deeper comprehension of the underlying problems, etc., all of which contribute to an improvement in both individual and public health.

The existence of a medical record that spans a whole lifetime is simply not feasible in the absence of standards. This is because the many records from various sources, which span around eighty years or more, need to be brought together in a meaningful manner. For the purpose of doing this, it is very necessary to have a collection of pre-defined standards for the collection, storage, retrieval, interchange, and analysis of information. These standards must contain clinical codes, data, and pictures.

2. Literature Review

[11] This review provides an overview of the development and standards for electronic health records (EHRs) from the 1990s onwards. By employing a comprehensive method of examining literature and consulting experts, more than 1200 requirements were discovered, and 203 were confirmed through expert feedback. Organised based on ISO 9126 and eEurope 2002 standards, important aspects cover worldwide needs, operational details, and information protection. The manuscript provides a thorough examination of mainly non-functional EHR requirements, addressing a crucial gap in the literature and offering valuable insights for EHR design and development.

[12] The possibility of using electronic health records (EHRs) to alleviate problems with recruitment, data collecting, and generalizability in clinical research is examined in this study. It sees EHRs as key data sources for observational studies, integrated pragmatic trials, and comparative

effectiveness studies. Furthermore, it explores the potential of utilising EHRs to simplify patient recruitment and data collection for randomised clinical trials. Addressing issues concerning data security, system integration, and ensuring data quality are essential for optimising the effectiveness of EHRs in clinical research. Working together with all parties involved is crucial for progressing the use of EHRs in cardiovascular research.

[13] The study evaluates the implementation of electronic health record (EHR) features designed for older adult care in US acute-care hospitals. It specifically looks at how hospitals document the 4Ms (What Matters, Medication, Mentation, and Mobility) and exchange health information with patients, carers, and long-term care providers. The research shows that even though certain hospitals have put in place organised documentation of the 4Ms, the overall acceptance is not ideal, especially for mental status. Likewise, the communication functions for exchanging information with long-term care facilities and providing training to patients/caregivers on EHR portals are not being fully utilised. The study highlights the importance of implementing policy interventions to enhance EHR capabilities in order to support evidence-based care for elderly patients in hospital environments.

[14] The study delves into the adoption and utilisation of electronic health record (EHR) functions in Turkish state hospitals, using the electronic medical record maturity model (EMRAM). The results show that 63.1% of Turkish hospitals have basic EHR functions, while 36% have comprehensive capabilities. This puts them in a favourable position compared to Korean hospitals but behind US counterparts. Smaller hospitals excel in specific EHR functions. The study highlights the strategic significance of measuring EHR adoption rates for efficient healthcare management. It demonstrates the success of a bottom-up approach in Turkey similar to the US model, offering valuable insights for nationwide EHR implementation endeavours.

[15] The research assesses the adoption rates of electronic health records (EHR) in public hospitals in Türkiye, by comparing results to a previous study and measuring against other countries like the US, Japan, and China. Analysis of survey data from 717 actively operating public hospitals in 2021 showed that 33.7% have basic EHR functions, while 66.3% have extensive capabilities, indicating notable advancements compared to earlier evaluations. Turkey's adoption rate outperforms China and Korea and slightly surpasses the US, showing significant progress in EHR implementation in the country.

[16] The research explores the connection between electronic health record (EHR) usability and nurse job outcomes, along with surgical patient outcomes. By examining data from 343 hospitals, 12,004 nurses, and 1,281,848 surgical patients, logistic regression models have uncovered important connections. Poorer EHR usability is linked to increased chances of nurse burnout, job dissatisfaction, intention to leave, and negative patient outcomes like inpatient mortality and 30-day readmission. It is worth mentioning that extensive EHR implementation is also associated with higher levels of nurse burnout. The importance of EHR usability in shaping nurse and patient experiences within healthcare settings is highlighted by these findings.

2.1 Research Gap

The research gap identified emphasises the necessity for a thorough investigation of Electronic Health Record (EHR) system implementation in large hospitals, covering aspects like challenges, training programmes, staff competency, and organisational awareness. Although there are numerous studies that have looked at specific elements of EHR adoption, there is still an area that has not been thoroughly investigated regarding how these factors work together and impact the overall success of EHR integration. Some studies have explored the connections between these factors and EHR adoption, but the influence of staff competency and organisational awareness has not been thoroughly examined. Connecting this gap would provide important insights into the complex dynamics of EHR implementation, helping to create more focused strategies to improve healthcare delivery and patient outcomes in large hospital settings.

2.2 Aim of the Study

The research will examine how difficulties, training programmes, staff competence, and organisational awareness affect Electronic Health Record (EHR) system installation in big hospitals. By investigating how these characteristics affect big hospital EHR adoption and use, the study fills research gaps. It does so to give insights that help improve EHR deployment strategies and healthcare delivery and patient outcomes.

2.3 Objectives

1. To identify the implementation challenges encountered during the integration of Electronic Health Record (EHR) systems in large hospitals.
2. To investigate the relationship between the utilization of training programs/support resources and the perceived benefits of EHR system adoption.
3. To explore the role of staff competency in EHR system usage as a mediator in the relationship between training programs/support resources and perceived benefits.
4. To examine the impact of organizational awareness on the overall performance of EHR system implementation in large hospitals.

2.4 Hypothesis

H_1: The effectiveness of EHR integration in large hospitals is positively impacted by implementation challenges.

H_2: Employing training programs and support resources positively effects on the perceived benefits of adopting an EHR system which is mediated by staff competency serving in a large hospital.

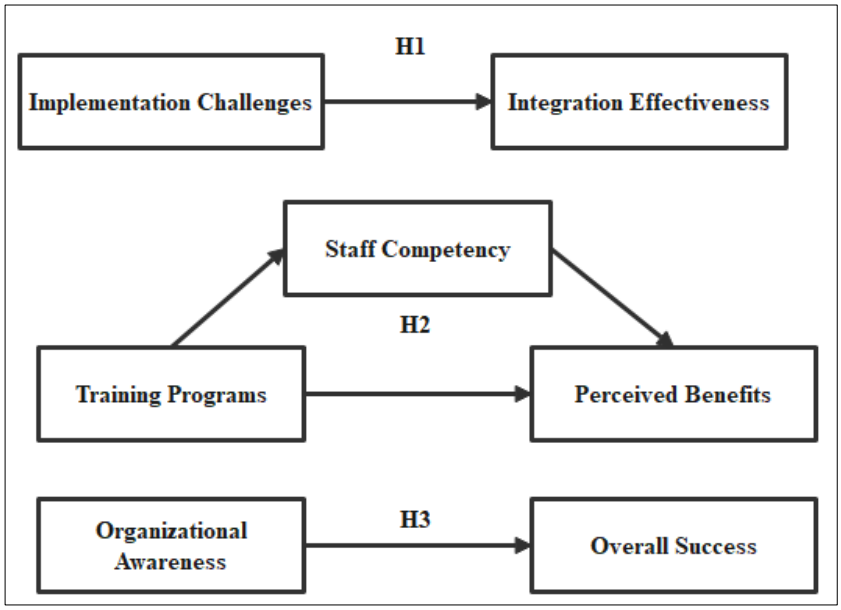
H_3: In large hospitals, the overall performance of EHR system implementation is significantly impacted by organizational awareness.

3. Research Methodology

The purpose of this research is to get a complete knowledge of the variables impacting the deployment and use of Electronic Health Record (EHR) systems in major hospital settings. The study attempts to uncover major predictors of

EHR performance by looking at integration problems, training programme efficacy, staff competence, and the influence of organisational awareness. For the purpose of achieving this objective, an effective research method has been established in order to effectively collect, evaluate, and analyse data.

3.1 Conceptual Framework



3.2 Research Design

This study is using quantitative approaches as its research strategy. The use of quantitative techniques, such as surveys or data analysis of EHR use statistics, may be used to look at the link between staff competence, organisational awareness, training programme utilisation, and perceived advantages of EHR adoption. This approach design would provide a thorough analysis of the study goals, giving the results both breadth and depth. The collected data will then be statistically analyzed, using Pearson's correlational analysis to investigate relationships between variables, and SEM analysis to identify predictive factors influencing.

3.3 Sampling Technique

The research will use a random sample approach to assure representativeness. 384 respondents aged 18 to 45 in the public and private hospital sectors will be chosen at random to participate in the questionnaire-based data collecting procedure.

3.4 Random Sampling

Random sampling, a strategy for selecting samples from a group of individuals, guarantees that every potential participant has an equal chance of being picked. A representative sample of the complete population may often be obtained by randomly selecting a sample from a group. Random sampling is among the most straightforward techniques for obtaining data from a large population.

When the population is only picked once, the random sampling formula is as follows.

$$P = 1 - \left(N - 1/N\right)\left(N - 2/N\right).....\left(N - n/N - (n-1)\right)$$

3.5 Data Collection

Gathering pertinent data is a critical component of every research endeavours. Primary data collection and secondary data collection are the two methods of information gathering that are most often employed. Using a questionnaire, the main data will be obtained. Aside from these places, books, essays, research papers, yearly reports, and periodicals and journals may also include secondary data.

3.6 Tools for Data collection

Surveys/questionnaires: To gather information from respondents, structured questions are used in surveys, which are tools for collecting data. Their usage in research is common, since they provide valuable perspectives on attitudes, beliefs, and experiences. Researchers may quantify data, look for trends, and understand the different perspectives of participants on a given topic by using surveys, which are an adaptable instrument.

3.7 Inclusion and Exclusion Criteria

- **Inclusion criteria:** Who had consented to participate in the study and provided personal information.
- **Exclusion criteria:** Those who were under the age of 18 at the time of data collection and who were unwilling to participate in the study were declined.

3.8 Tools and Techniques of this Study

Data Analysis

As part of our data analysis process, we looked at the information we had collected in a planned way to find useful insights. We used different statistical methods to look at the connections between key factors. In order to investigate the relationships between these factors and get insight into the processes influencing the perceived value of EHR systems, Structural Equation Modelling (SEM) analysis will be used. Moreover, a mediation analysis will be conducted to ascertain the function of certain components in moderating the correlation between the utilisation of training programmes and the perceived advantages of electronic health record adoption. This research uses a quantitative method to provide a thorough knowledge of the variables impacting the adoption and utilisation of EHRs in major

hospital settings, improving patient outcomes and healthcare delivery.

Results and Conclusion

Demographic Variables

Table 1: Demographic Information

Gender		
	Frequency	**Percent**
Male	186	48.4
Female	198	51.6
Total	384	100.0
Mean	1.515	
Age		
	Frequency	Percent
18-26 Years	96	25.0
27-35 Years	99	25.8
36-44 Years	88	22.9
Above 44 Years	101	26.3
Total	384	100.0
Mean	2.502	
Hospitals		
	Frequency	Percent
Private Hospitals	193	50.3
Government Hospitals	191	49.7
Total	384	100.0
Mean	1.497	
Staff Members		
	Frequency	Percent
Doctors	116	30.2
Nurses	143	37.2
Administrative staff	125	32.6
Total	384	100.0
Mean	2.023	

The demographic data of the 384 participants shows a balanced gender representation, with 186 men (48.4%) and 198 females (51.6%). The participants' average age shows a reasonably fairly distributed age range, with 96 (25.0%) aged 18 to 26 years, 99 (25.8%) aged 27 to 35 years, 88 (22.9%) aged 36 to 44 years, and 101 (26.3%) over 44 years old. In terms of hospital types, the sample includes 193 (50.3%) participants from private hospitals and 191 (49.7%) from government hospitals, demonstrating a fair representation of the two sectors. The sample includes 116 physicians (30.2%), 143 nurses (37.2%), and 125 administrative workers (32.6%), with a fairly balanced distribution across these groups. The mean values for gender, age, hospitals, and staff members are 1.515, 2.502, 1.497, and 2.023, respectively, indicating a diverse and representative demographic makeup among the research participants.

Structural Equation Model (SEM)

Structural Equation Modelling (SEM) is a powerful statistical method that enables a thorough examination of intricate connections among variables, whether they are visible or hidden. This method excels in analyzing complex causal connections, including hidden variables, testing multiple hypotheses simultaneously, addressing measurement errors, evaluating model accuracy, and blending aspects of factor analysis and regression. SEM plays a vital role in various fields such as psychology, sociology, economics, and beyond. It assists in validating theoretical models, evaluating the impacts of interventions or policies, and streamlining complex datasets. By adopting this thorough method, a more detailed and accurate examination of data and experimentation of theories is facilitated.

Exploring the Measurement Model and Ensuring Validity

Understanding measurement models and validity is crucial in research, as they provide a structured framework to guarantee the accuracy and importance of gathered data. Understanding measurement models can clarify the connections between observed variables and the underlying constructs, simplifying the assessment of intricate concepts. Precision is vital to ensure that measurement tools accurately capture the desired concepts, thereby preventing any chance of inaccurate or deceptive findings. Understanding measurement models and validity is essential in research, as they form the basis for reliable and credible results. Ensuring the credibility of this information is crucial for making informed decisions and furthering knowledge across different fields.

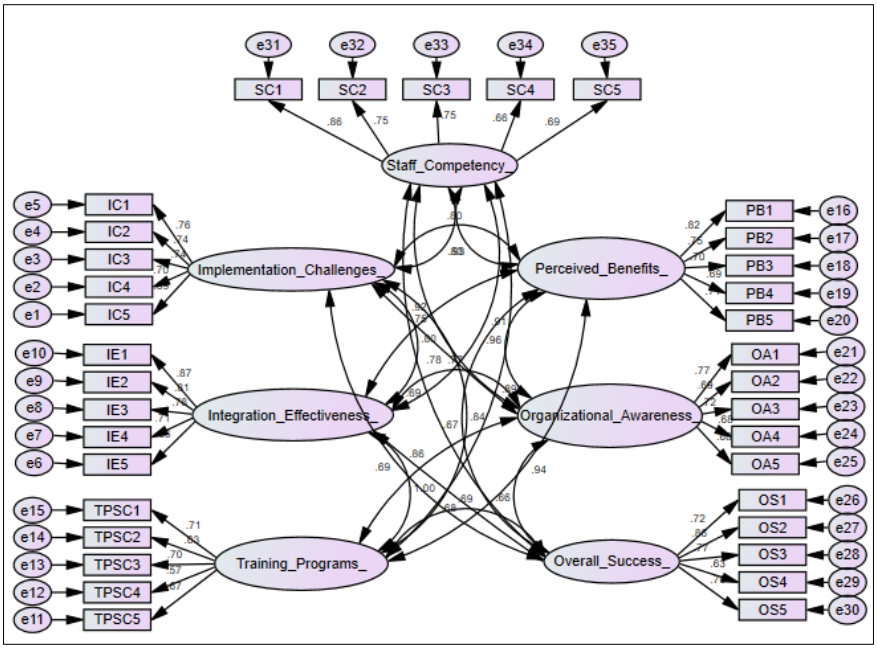


Fig 2: Measurement Model

Table 2: Regression Weights: (Group number 1 - Default model)

PATH			Unstandardized Estimate	S.E.	Standardized Estimate	P
IC5	<---	Implementation Challenges	1.000		.650	
IC4	<---	Implementation Challenges	.986	.081	.640	***
IC3	<---	Implementation Challenges	1.154	.085	.708	***
IC2	<---	Implementation Challenges	1.201	.097	.753	***
IC1	<---	Implementation Challenges	1.260	.097	.787	***
IE5	<---	Integration Effectiveness	1.000		.673	
IE4	<---	Integration Effectiveness	1.107	.088	.701	***
IE3	<---	Integration Effectiveness	1.180	.079	.783	***
IE2	<---	Integration Effectiveness	1.139	.089	.805	***
IE1	<---	Integration Effectiveness	1.655	.109	.866	***
TPSC5	<---	Training Programs	1.000		.688	
TPSC3	<---	Training Programs	1.067	.082	.721	***
TPSC2	<---	Training Programs	.801	.071	.641	***
TPSC1	<---	Training Programs	1.040	.085	.739	***
PB1	<---	Perceived Benefits	1.000		.852	
PB2	<---	Perceived Benefits	.794	.044	.779	***
PB3	<---	Perceived Benefits	.750	.050	.720	***
PB4	<---	Perceived Benefits	.732	.051	.735	***
PB5	<---	Perceived Benefits	.738	.048	.725	***
OA1	<---	Organizational Awareness	1.000		.760	
OA2	<---	Organizational Awareness	.760	.056	.691	***
OA3	<---	Organizational Awareness	.836	.059	.714	***
OA4	<---	Organizational Awareness	.762	.059	.660	***
OA5	<---	Organizational Awareness	.746	.056	.675	***
OS1	<---	Overall Success	1.000		1.224	
OS2	<---	Overall Success	.551	.045	.835	***
OS3	<---	Overall Success	.462	.042	.749	***
OS4	<---	Overall Success	.392	.044	.634	***
OS5	<---	Overall Success	.462	.040	.794	***
SC1	<---	Staff Competency	1.000		.857	
SC2	<---	Staff Competency	.725	.042	.744	***
SC3	<---	Staff Competency	.723	.039	.746	***
SC4	<---	Staff Competency	.610	.041	.674	***
SC5	<---	Staff Competency	.694	.043	.710	***

Table 3: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.965
Bartlett's Test of Sphericity	Approx. Chi-Square	8651.135
	DF	561
	Sig.	.000

KMO and Bartlett's tests to assess the suitability for factor analysis. The obtained KMO value was 0.965, indicating high sampling adequacy, and the Bartlett's test was highly significant (P = 0.00), supporting the factor analysis.

We employed Confirmatory Factor Analysis (CFA) to rigorously examine the validity of our instrument. The factor loadings for each individual question exceeded the 0.5 threshold, underscoring the instrument's strong capability to accurately measure the intended constructs. This outcome underscores the robustness of our measurement tool. some items are removed from further analysis as the factor loading value is below 0.6. The model fit values are as exhibited in Table 5. To assess the internal consistency of the scale, we computed Average Variance Extracted (AVE) and Composite Reliability (CR). Table 3 presents the post-Confirmatory Factor Analysis (CFA) results, including Cronbach's alpha, AVE, and CR values. Discriminant validity is established if the square root of the AVE for a variable is greater than its correction values when compared with other variables. The findings that were collected are shown in Table 4, and they contribute to the determination of the discriminant validity.

Table 4: Post CFA, Cronbach alpha, factor loadings

Factors and items	Cronbach alpha values	Post CFA factor loadings	AVE	CR
Implementation Challenges	.850		0.706	0.448
IC1		.787		
IC2		.753		
IC3		.708		
IC4		.640		
IC5		.650		
Integration Effectiveness	.872		0.765	0.4877
IE1		.866		
IE2		.805		
IE3		.783		
IE4		.701		
IE5		.673		
Training Programs	.770		0.679	0.3415
TP1		.739		
TP2		.641		
TP3		.721		
TP4		.688		
Perceived Benefits	.854		0.762	0.4855
PB1		.852		
PB2		.779		
PB3		.720		
PB4		.735		
PB5		.725		
Organizational Awareness	.835		0.70	0.4432
OA1		.760		
OA2		.691		
OA3		.714		
OA4		.660		
OA5		.675		
Overall Success	.852		0.765	0.4874
OS1		0.814		
OS2		.835		
OS3		.749		
OS4		.634		
OS5		.794		
Staff Competency	.857		0.746	0.4609
SC1		.857		
SC2		.744		
SC3		.746		
SC4		.674		
SC		.710		

Discriminant validity

Discriminant validity is not a specific test performed in SPSS or any other statistical software but a concept within the context of validating measurement instruments and assessing the relationships between variables. Discriminant validity is crucial to ensure that different constructs or variables in a study are truly distinct and not measuring the same underlying concept. Researchers use various techniques such as confirmatory factor analysis (CFA) or correlation analysis to demonstrate that the measures intended to assess different constructs are, indeed, different and not highly correlated. Discriminant validity helps ensure that the measurement instruments accurately represent the unique concepts they are meant to measure, preventing construct overlap or redundancy and allowing for more robust and accurate data analysis and interpretation.

Table 5: Discriminant Validity Test

	Implementation Challenges	Integration Effectiveness	Training Programs	Perceived Benefits	Organizational Awareness	Overall Success	Staff Competency
Implementation Challenges	0.8411						
Integration Effectiveness	.840**	0.8749					
Training Programs	.845**	.850**	0.8350				
Perceived Benefits	.627**	.604**	.678**	0.8730			
Organizational Awareness	.924**	.766**	.779**	.571**	0.8366		
Overall Success	.786**	.877**	.760**	.550**	.702**	0.8747	
Staff Competency	.307**	.348**	.344**	.348**	.262**	.299**	0.8638

The discriminant validity test examines the distinctiveness of constructs in a study concerning the adoption of digital payment, convenience and utility perception, smartphone ownership, trust in the digital payment system, and level of digital literacy. The correlation matrix indicates strong correlations among these constructs, with coefficients ranging from .678 to .824. However, the diagonal values (shown in bold) represent the square root of the average variance extracted (AVE) for each construct, which are notably higher than the correlations between constructs. This suggests sufficient discriminant validity, as the constructs exhibit higher correlation with their respective measures than with other constructs, affirming the distinctiveness of each construct in the study.

Table 6: Model fit summary

Variable	Value
Chi-square value(χ^2)	965.24
Degrees of freedom (DF)	467
CMIN/DF	2.067
P value	0.000
GFI	0.866
RFI	0.870
NFI	0.892
IFI	0.941
CFI	0.941
RMR	0.045
RMSEA	0.053

The quality of fit was acceptable representation of the sample data (χ^2 = 965.24), NFI (Normed Fit Index) =0.892; IFI (Incremental fit index) = 0.941, GFI (Goodness of Fit) = 0.866, RFI (Relative Fit Index) = 0.870 and CFI (Comparative Fit Index) = 0.941 which is much larger than the 0.80. Similarly, RMR (Root Mean Square Residuals) =0.045 and RMSEA (Root mean square error of approximation) = 0.053 values are lower the 0.080 critical value**.** Results indicated a good fit for the model presented including RMSEA of 0.053, RMR of 0.045, GFI of 0.866, and CFI of 0.941.

4.1 Hypothesis Testing

H_1: The effectiveness of EHR integration in large hospitals is positively impacted by implementation challenges.

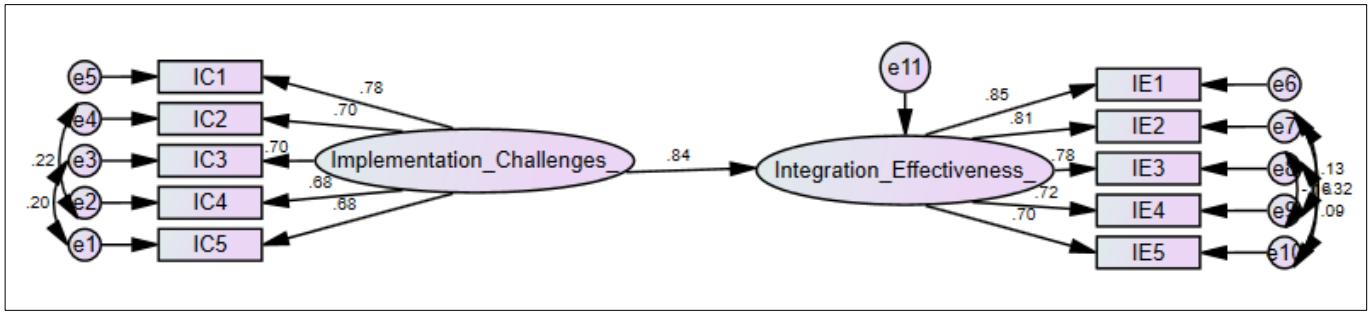


Fig 3: H1 SEM Model

Table 7: Regression Weights: (Group number 1 - Default model)

PATH			Unstandardized Estimate	S.E.	Standardized Estimate	P
Integration Effectiveness	<---	Implementation Challenges	1.338	.111	.839	***
IC5	<---	Implementation Challenges	1.000		.677	
IC4	<---	Implementation Challenges	1.010	.089	.682	***
IC3	<---	Implementation Challenges	1.094	.082	.699	***
IC2	<---	Implementation Challenges	1.074	.092	.701	***
IC1	<---	Implementation Challenges	1.200	.094	.781	***
IE1	<---	Integration Effectiveness	1.000		.851	
IE2	<---	Integration Effectiveness	.703	.039	.808	***

IE3	<---	Integration Effectiveness	.726	.042	.784	***
IE4	<---	Integration Effectiveness	.697	.046	.718	***
IE5	<---	Integration Effectiveness_	.636	.044	.696	***

The results of the regression analysis in Table 1 demonstrate the connection between implementation challenges and the effectiveness of Electronic Health Record (EHR) integration in large hospitals. Based on the standardized estimates, it appears that implementation challenges have a notable positive effect on integration effectiveness. Based on the estimate of 1.338 with a standard error of 0.111, the standardized estimate is 0.839, suggesting a significant positive correlation between implementation challenges and integration effectiveness ($p < 0.001$). In addition, the regression weights for each individual implementation challenge (IC1 through IC5) demonstrate positive standardized estimates ranging from 0.677 to 0.781, all of which are statistically significant ($p < 0.001$).

In addition, the regression coefficients for integration effectiveness (IE1 through IE5) show positive standardized estimates between 0.696 and 0.851, indicating a significant positive correlation between integration effectiveness and the perceived advantages of EHR adoption. Based on the results, it is clear that even with the difficulties encountered during implementation, major hospitals see a boost in EHR integration effectiveness, resulting in better outcomes and advantages. Based on the regression analysis results, it is evident that there is strong support for the hypothesis that the effectiveness of EHR integration in large hospitals is positively influenced by implementation challenges. It is indicated that successfully addressing challenges during implementation can enhance the integration of EHR systems in large hospital settings, resulting in better healthcare delivery and patient outcomes.

Table 8: Model Fit Summary

Variable	Value
Chi-square value(χ^2)	90.934
Degrees of freedom (DF)	28
CMIN/DF	3.248
P value	0.000
GFI	0.953
NFI	0.956
RFI	0.930
IFI	0.969
CFI	0.969
RMR	0.040
RMSEA	0.077

The quality of fit was acceptable representation of the sample data ($\chi 2 = 90.934$), NFI (Normed Fit Index) = 0.956; IFI (Incremental fit index) = 0.969, GFI (Goodness of Fit) = 0.953, RFI (Relative Fit Index) = 0.930 and CFI (Comparative Fit Index) = 0.969 which is much larger than the 0.90. Similarly, RMR (Root Mean Square Residuals) = 0.040 and RMSEA (Root mean square error of approximation) = 0.077 values are lower the 0.080 critical value. Results indicated a good fit for the model presented including RMSEA of 0.077, RMR of 0.040, GFI of 0.953, and CFI of 0.969.

H_2: Employing training programs positively effects on the perceived benefits of adopting an EHR system which is mediated by staff competency serving in a large hospital.

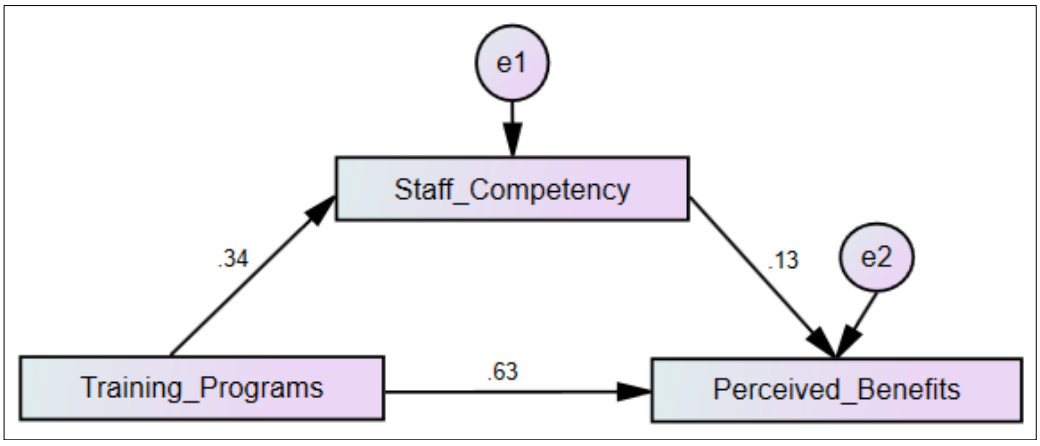


Fig 4: H2 Moderate Model

Table 9: Regression Weights: (Group number 1 - Default model)

PATH			Unstandardized Estimate	S.E.	Standardized Estimate	P
Staff Competency	<---	Training Programs	.802	.129	.302	***
Perceived Benefits	<---	Staff Competency	.067	.017	.145	***
Perceived Benefits	<---	Training Programs	.816	.045	.670	***

According to hypothesis H2, staff competence is used as a mediator between the introduction of training programs and the perceived advantages of adopting Electronic Health Record (EHR) systems in major hospital settings. As shown in Table 8, the structural equation model provides evidence for this hypothesis. Based on the analysis, it is evident that there is a strong positive correlation between involvement in training programs and staff competency in using EHR systems. The results show that increased participation in training programs improves staff competency. Moreover, the connections between staff competency and perceived benefits (unstandardized estimate = 0.067, standardized

estimate = 0.145, p < 0.001) as well as training programs and perceived benefits (unstandardized estimate = 0.816, standardized estimate = 0.670, p < 0.001) show notable positive relationships. These findings indicate that training programs impact the perceived benefits of EHR adoption, which is influenced by staff competency. Therefore, highlighting the importance of staff training in promoting positive perceptions and outcomes related to EHR utilization in large hospital settings.

H_3: In large hospitals, the overall performance of EHR system implementation is significantly impacted by organizational awareness.

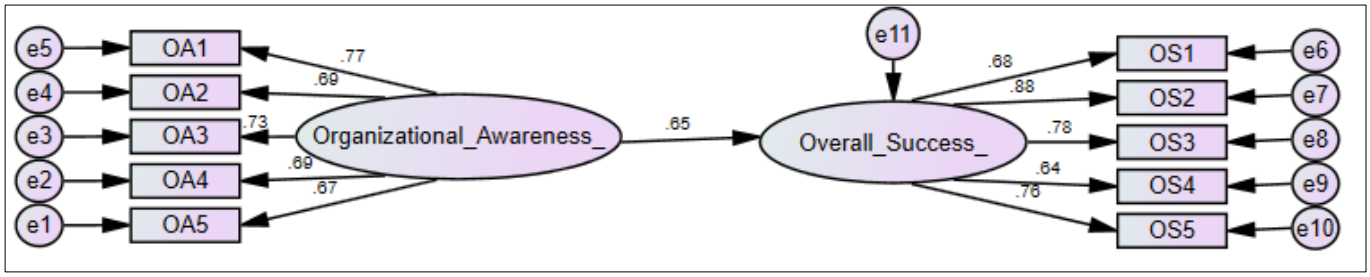


Fig 5: H3 SEM Model

Table 10: Regression Weights: (Group number 1 - Default model)

PATH			Unstandardized Estimate	S.E.	Standardized Estimate	P
Overall Success	<---	Organizational Awareness	.924	.103	.651	***
OA5	<---	Organizational Awareness	1.000		.669	
OA4	<---	Organizational Awareness	1.084	.094	.694	***
OA3	<---	Organizational Awareness	1.158	.096	.731	***
OA2	<---	Organizational Awareness	1.026	.090	.688	***
OA1	<---	Organizational Awareness	1.363	.110	.766	***
OS1	<---	Overall Success	1.000		.678	
OS2	<---	Overall Success	1.045	.071	.876	***
OS3	<---	Overall Success	.871	.065	.781	***
OS4	<---	Overall Success	.718	.063	.643	***
OS5	<---	Overall Success	.801	.061	.761	***

The regression analysis in Table 3 delves into the connection between organizational awareness and the overall performance of Electronic Health Record (EHR) system implementation in large hospitals. Based on the standardized estimates, it is clear that organizational awareness has a notable positive influence on the overall success of EHR system implementation. With an unstandardized estimate of 0.924 and a standard error of 0.103, the resulting standardized estimate of 0.651 suggests a significant positive correlation between organizational awareness and overall success (p < 0.001). In addition, the regression coefficients for each individual aspect of organizational awareness (OA1 to OA5) show positive standardized estimates between 0.669 and 0.766, all of which are statistically significant (p < 0.001). In addition, the regression weights for overall success (OS1 through OS5) show positive standardized estimates ranging from 0.643 to 0.876, indicating a strong positive correlation between overall success and the perceived performance of EHR system implementation in large hospitals. These findings suggest that a greater organizational awareness can enhance the success of EHR system implementation, resulting in better outcomes and performance. Ultimately, the results of the regression analysis strongly support the idea that organizational awareness has a significant impact on the overall performance of EHR system implementation in large hospitals. Indications point to the fact that promoting organizational awareness about EHR system implementation could result in increased success and efficiency in large hospital settings, ultimately improving healthcare delivery and patient care.

Table 11: Model fit summary

Variable	Value
Chi-square value(χ^2)	114.450
Degrees of freedom (DF)	34
CMIN/DF	3.366
P value	0.000
GFI	0.942
NFI	0.935
RFI	0.915
IFI	0.954
CFI	0.953
RMR	0.051
RMSEA	0.079

The quality of fit was acceptable representation of the sample data ($\chi 2$ = 114.450), NFI (Normed Fit Index) = 0.935; IFI (Incremental fit index) = 0.954, GFI (Goodness of Fit) = 0.942, RFI (Relative Fit Index) = 0.915 and CFI (Comparative Fit Index) = 0.953 which is much larger than the 0.90. Similarly, RMR (Root Mean Square Residuals) = 0.051 and RMSEA (Root mean square error of approximation) = 0.079 values are lower the 0.080 critical value. Results indicated a good fit for the model presented including RMSEA of 0.079, RMR of 0.051, GFI of 0.942, and CFI of 0.953.

5. Conclusion

The results of the structural equation modelling (SEM) research reveal a number of noteworthy conclusions that provide insight into the intricate dynamics affecting how well Electronic Health Record (EHR) integration works in

big hospital environments. First off, the study's findings support the notion that implementation issues are a major factor influencing how well EHR integration works, and they also imply that resolving and minimising these issues might improve the results of integration. This emphasises how crucial it is to use proactive approaches to get beyond obstacles that arise during the implementation stage, including interoperability problems, opposition to change, and technical difficulties.

Furthermore, the study indicates that training initiatives have a significant influence on staff competence and the perceived advantages of electronic health record usage. According to the results, funding extensive training programmes both directly and indirectly raises staff proficiency in using EHR systems and adds to the benefits that users perceive from using EHRs. This emphasises how important it is for healthcare workers to have continual training and professional development so they can maximise the advantages of adopting EHR technology by having the skills and knowledge needed to use them successfully.

The report also emphasises how important organisational knowledge is to the overall success of EHR system deployment projects in major hospital settings. According to the results, one of the most important factors in promoting effective integration outcomes is developing an organisational awareness culture in which stakeholders are knowledgeable and actively involved in the EHR implementation process. In order to guarantee seamless transitions and long-lasting gains in healthcare service, this highlights the significance of strategic communication, leadership buy-in, and organisational alignment across all phases of the implementation journey. The study's conclusions emphasise the complexity of EHR integration in major institutions and the interactions that exist between staff competence, training initiatives, organisational awareness, and implementation issues. Healthcare organisations may increase the efficacy of their EHR integration efforts and ultimately improve patient outcomes, organisational efficiency, and healthcare delivery by taking a holistic approach to tackling these aspects. This emphasises how crucial it is to deploy EHRs in a comprehensive manner that takes into account not only the technological components but also the organisational and human elements that are crucial for success in big hospital settings.

Conflict of Interest
Not available

Financial Support
Not available

References

1. AUI, AOJS, AOI. Image. Value of the Electronic Medical Record for Hospital Care: Update from the Literature. Journal of Medical Internet Research. 2021;23(12):e317.
2. Evans RS. Electronic Health Records: Then, Now, and in the Future. Yearbook of Medical Informatics. 2016;25(1):S48-S61. DOI: 10.15265/IYS-2016-s006.
3. Ornstein SM, Oates RB, Fox GN. The computer-based medical record: Current status. Journal of Family Practice. 1992;35(5):556-565.
4. Kovačić M, Mutavdžija M, Buntak K. E-Health Application, Implementation and Challenges: A Literature Review. Business Systems Research Journal. 2022;13(1):01-18. DOI: 10.2478/bsrj-2022-0001.
5. Safran C. Towards a National Framework for the Secondary Use of Health Data AMIA's position; c2006.
6. HG, Reponen J, Nøhr C, Villumsen S, Koch S, Hardardottir GA. Nordic eHealth benchmarking; c2015. [Online]. Available: books.google.com
7. Orfanidis L, Bamidis PD, Eaglestone B. Data quality issues in electronic health records: An adaptation framework for the Greek health system. Health Informatics Journal. 2004;10(1):23-36. DOI: 10.1177/1460458204040665.
8. Voss WG. European union data privacy law reform: General data protection regulation, privacy shield, and the right to delisting. The Business Lawyer. 2016;72(1):221-233.
9. Burns J. Product specification: The fifth discipline of health care. europepmc.org; c1993.
10. Ministry of Health & Family Welfare. EHR Standards for India. Electron Heal Rec Stand India. 2016, 1-48. [Online]. Available: http://www.mohfw.nic.in/showfile.php?lid=4138
11. Hoerbst A, Ammenwerth E. Electronic health records: A systematic review on quality requirements. Methods of Information in Medicine. 2010;49(4):320-336. DOI: 10.3414/ME10-01-0038.
12. Cowie MR, *et al*. Electronic health records to facilitate clinical research. Clinical Research in Cardiology. 2017;106(1):01-09. DOI: 10.1007/s00392-016-1025-6.
13. Adler-Milstein J, *et al*. Hospital adoption of electronic health record functions to support age-friendly care: results from a national survey. Journal of the American Medical Informatics Association. 2020;27(8):1206-1213. DOI: 10.1093/jamia/ocaa129.
14. Kose I, *et al*. Adoption rates of electronic health records in Turkish Hospitals and the relation with hospital sizes. BMC Health Services Research. 2020;20(1):01-16. DOI: 10.1186/s12913-020-05767-5.
15. Köse İ, *et al*. Basic electronic health record (EHR) adoption in Türkiye is nearly complete but challenges persist. BMC Health Services Research. 2023;23(1):01-11. DOI: 10.1186/s12913-023-09859-w.
16. Ann Kutney-Lee JMBC. Electronic Health Record Usability: Associations with Nurse and Patient Outcomes in Hospitals. A National Institutes Health; c2021.

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