

Leveraging Artificial Intelligence to Assess Physicians' Willingness to Share Electronic Medical Records in a Hierarchical Diagnostic Ecosystem

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ABSTRACT

In order to promote the practice of the hierarchical diagnosis system in China, we looked into electronic medical record-the important information carrier of patient health data. Based on literature reading and pre-investigation, a model of influencing factors of doctors' willingness to use and share electronic medical records under the background of the implementation of the hierarchical diagnosis and treatment system was constructed. The questionnaire was designed with the traditional model and the questionnaire data were collected. The structural equation model was used to test the constructed model. The results show that the perceived usefulness of electronic medical records has the most significant impact on the willingness to share. Perceived ease of use and privacy protection of patient information have significant effects on sharing intention. In the future, the construction of electronic medical record system should be based on improving its use value and considering its convenience.

1. Introduction

With the rapid advancement of information technology, electronic medical records (EMRs) are widely adopted in hospitals worldwide [52, 20, 44, 55, 33]. According to the Institute of Medicine's definition, an electronic medical record (EMR) is health information stored electronically, encompassing personal health status and medical records [1]. Throughout its development, EMRs have become a primary medium of information in healthcare systems, fulfilling the diagnostic, management, and legal needs of hospitals, physicians, and patients [54, 18]. In the early stages, the construction of EMRs in China faced challenges such as vague conceptual understanding, limited national research projects, and a lack of unified standards [9]. In September 2010, the Ministry of Health issued a notice regarding the pilot implementation of electronic medical records, marking the official commencement of such initiatives and facilitating the establishment and improvement of hospital information systems centered around EMRs. In 2018, the State Council of the People's Republic of China issued guidelines to promote the development of "Internet + Healthcare" [7], which emphasized the acceleration of medical information infrastructure, including the construction of electronic medical record databases. Recently, with the ongoing wave of healthcare informationization, the development of mobile healthcare has provided innovative ideas for the construction of healthcare systems in various countries, leading to a gradual acceleration of medical information infrastructure development and a growing demand [47, 38]. An important policy background for the increasing emphasis on electronic

medical records (EMRs) is the implementation of a hierarchical diagnosis and treatment system [38, 30, 48, 5, 10, 11, 53]. The aim of establishing this tiered healthcare system is to address the long-standing issue of uneven distribution of medical resources in China, characterized by overcrowded tertiary hospitals and underutilized community hospitals [45, 34]. Recent experiences in combating the COVID-19 pandemic have demonstrated that strengthening the referral role of primary healthcare institutions during peak periods of medical demand, such as outbreaks of infectious diseases [46, 25], can help prevent the phenomenon of medical resource congestion. In the implementation of the hierarchical diagnosis and treatment system, patients typically seek initial care at primary healthcare facilities, where primary care physicians utilize basic medical equipment to assess and document patients' health conditions [31, 15]. When community hospitals are unable to provide effective rehabilitation due to limitations in medical equipment and technology, patients must be referred to higher-level hospitals within the medical alliance referral system.

Before the widespread adoption of electronic medical records (EMRs), patients faced significant challenges when using paper-based records for referrals due to the physical nature of these documents, which often led to difficulties in storage and complex referral procedures [23]. Although the prevalence of EMRs in China has increased, many frontline physicians still report issues related to the mixed use of paper and electronic records within the hierarchical diagnosis and treatment system [17]. These issues include incomplete patient information and doubts regarding the accuracy of EMR data. Clearly, the completeness, effectiveness, and reliability of electronic medical records play a crucial role in the successful implementation of the hierarchical diagnosis and treatment system [50]. Furthermore, the low level of informatization of EMRs in healthcare institutions can create

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practical difficulties for physicians in their clinical practice. In managing and referring patients, electronic medical records serve as a vital repository of medical information and are an essential basis for physicians' medical decision-making [6].

Numerous studies have investigated the promotion logic of electronic medical records (EMRs) and the willingness of different groups to use them. Zhang et al. summarized the factors influencing the willingness of various groups to utilize electronic health systems, including EMRs, from an international research perspective [51]. Their research highlighted the context of digital information infrastructure and the development of digital health concepts; however, it primarily focused on the willingness of general users. Beldad and Hegner examined the willingness of the German public to use health information systems, finding that trust, health information records, and social interaction are significant considerations for users [4]. In contrast, it was pointed out that, unlike the bottom-up promotion of EMRs seen abroad, the core process of EMR promotion in China is driven by managerial directives, with healthcare professionals accepting their use while patients and doctors are not the primary advocates for the EMR system [46]. Several studies have specifically explored the factors influencing physicians' willingness to use EMRs. For instance, Chun et al. conducted a survey of all clinical physicians at a tertiary hospital in Luoyang and found that the willingness of clinical physicians to use EMRs is significantly affected by factors such as system security and organizational change [8].

Review for literatures shows that although scholars have acknowledged the significance of studying physicians' willingness to use electronic medical records (EMRs) within the context of their promotion in China, there is a general lack of consideration for domestic realities in the research community. While the international experiences regarding the dissemination of EMRs and the exploration of usage willingness provide valuable insights for the development of EMRs in China, they exhibit certain limitations. First, the processes of EMR adoption in China differ from those abroad, leading to deviations in usage willingness. Second, there is a scarcity of literature examining the willingness to use EMRs from the perspective of hierarchical diagnosis and treatment systems. Within this context, physicians' willingness to use EMRs may be influenced by unique factors related to the hierarchical diagnosis and treatment framework. This study conducted preliminary research among physicians to obtain an initial understanding of the factors affecting their willingness to share EMRs. Building on this foundation and integrating insights from the literature, a model for investigating the factors influencing physicians' willingness to use EMRs was developed based on the Technology Acceptance Model (TAM). The aim is to systematically analyze the factors affecting physicians' willingness to use EMRs, thereby assisting patients, physicians, and healthcare institutions in optimizing the implementation details of EMRs and promoting the rational allocation of medical

information resources and human resources across different hospitals.

2. Literature Review and Hypotheses

The factors influencing physicians' willingness to use electronic medical records (EMRs) and their satisfaction with these systems are complex. This study employs the Technology Acceptance Model (TAM) [12] as a framework to establish a model of factors affecting physicians' intentions to use EMRs, drawing from both theoretical and practical perspectives in the context of specific medical practice issues within the hierarchical diagnosis and treatment system. Initially, a comprehensive review of the theoretical literature regarding the implementation background and policy objectives of the hierarchical diagnosis and treatment system was conducted. Following this literature review, an interview outline was designed to facilitate in-depth discussions with physicians who use EMRs, allowing for the synthesis of their feelings and opinions regarding the use of electronic medical records. These insights were categorized into different types of factors influencing EMR usage. To enhance the model's interpretability and communicability within this field, concepts from the classic Technology Acceptance Model were integrated, along with the interview data for factor inclusion. By examining the logical relationships among the concepts and reviewing the literature, this research constructs a model of factors influencing the willingness to use EMRs under the hierarchical diagnosis and treatment system, which is illustrated in Figure 1, depicting the hypothesized relationships among the factors to be tested.

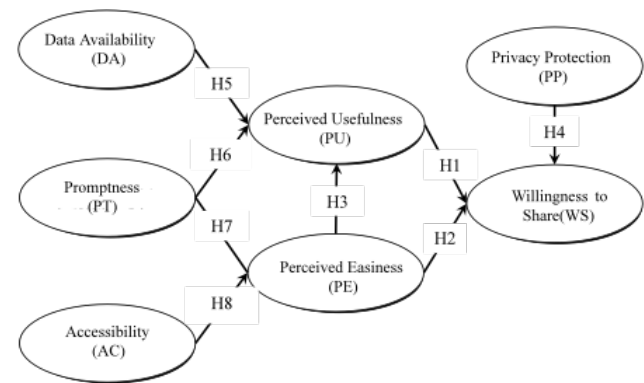


Figure 1: The influence model of electronic medical record usage willingness under the hierarchical diagnosis and treatment system.

2.1. Technology Acceptance Model

Based on the Theory of Reasoned Action (TRA), Davis proposed the Technology Acceptance Model (TAM), which emphasizes that users' behavioral intentions are key determinants of their actual usage behavior. Users' behavioral intentions are influenced by two endogenous variables: Perceived Usefulness (PU) and Perceived Ease of Use (PE). Perceived Ease of Use directly affects Perceived Usefulness,

while exogenous variables within specific application contexts also significantly impact both Perceived Usefulness and Perceived Ease of Use. By considering external environmental factors, one can gain a deeper understanding of the motivations and willingness of users to engage with the system [12, 36]. The hierarchical diagnosis and treatment system promotes the adoption of electronic medical records (EMRs), which offer numerous advantages over paper-based records, thereby reducing the reliance on physical documents [41]. When physicians recognize that the EMR system allows them to access patients' personal health information more quickly and enhances diagnostic efficiency, they are likely to feel that the sharing of EMRs within medical alliances improves their work efficiency. This positive perception can naturally lead to an increased willingness to use EMRs. In fact, empirical research by [35] has confirmed that physicians' Perceived Ease of Use of EMR systems positively influences their perception of the complexity of the diagnostic and treatment process. However, this study primarily derived the latent variables of Perceived Usefulness and Perceived Ease of Use through overly direct questioning, without addressing specific inquiries related to Perceived Usefulness within the context of hierarchical diagnosis and treatment practices [3]. Based on the above discussion, this study proposes the following hypotheses:

H1: Physicians' Perceived Usefulness of EMRs positively influences their willingness to share usage.

H2: Physicians' Perceived Ease of Use of EMRs positively influences their willingness to share usage.

H3: Physicians' Perceived Ease of Use of EMRs positively influences their Perceived Usefulness.

2.2. Factors Influencing the Willingness to Use Electronic Medical Records under the Hierarchical Diagnosis and Treatment System

Under the hierarchical diagnosis and treatment system, whether in community hospitals, secondary hospitals, or tertiary hospitals, if different levels of hospitals are part of the same medical alliance, physicians can access a unique electronic medical record (EMR) for each patient when they seek care at different facilities. Although the promotion of EMRs has addressed several issues associated with traditional paper records, such as difficulties in preservation and retrieval, it does not eliminate existing challenges related to the flow of patient information [5]. Through preliminary interviews and a review of the literature, the author has summarized several specific factors influencing physicians' willingness to use EMRs within the hierarchical diagnosis and treatment system.

(1) Privacy Protection of the EMR Sharing System (Privacy Protection, PP)

Common practices both domestically and internationally indicate that the promotion of EMRs is accompanied by concerns about the potential leakage of patients' health information. Zhang et al. reviewed existing studies on users' continued willingness to use electronic health information

systems and found that patients' emphasis on privacy protection moderates their willingness to continue using such systems [51]. With the widespread use of the Internet, electronic health records contain vast amounts of patient health information, and unauthorized access to this information can have severe consequences [26]. If patients become aware of leaks in their health information contained within their EMRs, it undermines medical ethics and can negatively impact the doctor-patient relationship [28]. This concern is particularly acute for patients with sensitive health conditions, as breaches of their health information can lead to detrimental effects on the doctor-patient relationship and contradict the interests of the medical community [21]. Under the hierarchical diagnosis and treatment system, the same EMR is shared among physicians across different institutions, allowing for the exchange of patient health information between various levels of hospitals. Given the significance of privacy protection in influencing the doctor-patient relationship, the following hypothesis is proposed:

H4: Physicians' recognition of the privacy protection features of EMRs positively influences their willingness to share usage.

(2) Data Availability of Electronic Medical Record Patient Data (Data Availability, DA)

The informatization of healthcare is a crucial initiative for deepening medical reform [32]. In the context of the hierarchical diagnosis and treatment system, although progress has been made in the promotion of electronic medical records (EMRs) as a hallmark of healthcare informatization, the exchange of EMRs within medical alliances still faces significant obstacles. Establishing a basic and comprehensive information system in individual healthcare institutions is foundational for constructing a regional health information platform within medical alliances [49]. However, the level of informatization varies significantly among different healthcare institutions within the alliance. First, the information systems in various hospitals are managed by different companies. Second, the data structures of patient EMR information may differ between companies, and the completeness of EMR systems managed by companies with varying economic strengths can also differ. This leads to heterogeneous EMR data across healthcare institutions within the alliance, thereby reducing the value of EMR sharing [19, 37]. Preliminary research with physicians also revealed that discrepancies in measurement accuracy and methods between the medical equipment of primary healthcare institutions and that of higher-level institutions result in inconsistencies in the actual meaning of data, even when numerical values are the same. Consequently, merging data from different levels of healthcare institutions becomes challenging. The varying degrees of informatization among institutions often lead to the continued use of paper records during patient referrals, making it difficult to integrate these records with EMRs, which reduces their effectiveness [39]. Given these considerations, the availability of patient data, defined by whether EMRs can be effectively utilized across different institutions, is a key factor influencing whether

EMR sharing can facilitate the hierarchical diagnosis and treatment system. Based on the above discussion, the following hypothesis is proposed:

H5: Physicians' perception of the availability of patient data within EMRs positively influences their perception of ease of use.

(3) Timeliness of Electronic Medical Record Information Updates (Promptness, PT)

In the electronic medical record sharing system, timeliness refers to the system's ability to promptly import, update, upload, and share patient health data. Physicians must formulate treatment plans that best match the current status of their patients based on the latest health information [2]. In the context of the hierarchical diagnosis and treatment system, when patients seek referrals to higher-level hospitals after receiving treatment at primary healthcare institutions, the primary institution must upload the patient's new medical condition. The receiving higher-level hospital must be capable of quickly accessing the patient's latest health information. Ke and Chen indicate that "Internet Plus" technology allows various medical data, including EMRs, to be updated in real-time within 24 hours, providing continuous information support for clinical diagnosis [22]. Therefore, when physicians attend to referred patients, they can quickly conduct more efficient diagnoses based on the diagnostic information displayed in the EMRs from the lower-level institution. The role of EMRs as carriers of patient health information is thereby fully realized. Furthermore, physicians can enhance the efficiency of data entry by utilizing templates and copy functions [42]. Once editing permissions for EMRs are granted to authorized physicians, they can quickly use digital signatures to take responsibility for the entered patient health information. Once uploaded, EMRs can be swiftly stored in the information system's database, making record-keeping easier compared to paper records, thus improving the convenience of using EMRs. Based on the above discussion, the following hypotheses are proposed:

H6: In the context of the hierarchical diagnosis and treatment system, the timeliness of EMR information updates positively influences perceived usefulness.

H7: In the context of the hierarchical diagnosis and treatment system, the timeliness of EMR information updates positively influences perceived ease of use.

(4) Accessibility of Electronic Medical Record Patient Data (Accessibility, AC)

From the perspective of physicians, the use of electronic medical records (EMRs) facilitates quick access to essential patient information, including medical history, diagnostic results, and examination reports [27]. In China, the extensive healthcare system must continuously meet the growing demands for medical care and health services, leading to a sharp increase in outpatient and inpatient records [43]. To address the rising need for patient consultations and enhance treatment efficiency, physicians view improved access to patient information as a critical necessity [24, 29]. With certain access rights to a cross-hospital database, physicians

can swiftly retrieve health information based on individual patient profiles. Furthermore, traditional paper records, which are handwritten by various physicians, often present challenges in legibility [13]. In contrast, the templated nature of EMR editing, with pre-loaded technical terminology and standardized printed formats, enhances the readability of patient data and significantly improves physicians' efficiency in obtaining health information. Based on the above discussion, the following hypothesis is proposed:

H8: Physicians' perception of the accessibility of patient data within EMRs positively influences their perception of ease of use.

3. Research Design

3.1. Questionnaire Design and Survey

This study is based on a traditional information technology system usage model as its fundamental framework, referencing survey scales from relevant literature while considering the unique context of the hierarchical diagnosis and treatment system. A questionnaire was designed to validate the proposed model, employing a five-point Likert scale. The questionnaire includes six latent variables, each accompanied by 2-3 corresponding observed variables. During the initial phase of questionnaire distribution, feedback was solicited from a group of physicians meeting the research criteria, leading to revisions that resulted in the final questionnaire, as shown in Table 1. The questionnaire is divided into two main sections: basic sample information and variable measurement. After collecting the completed questionnaires, data from responses that did not meet the criteria were excluded to ensure data quality. The distribution and collection period of the questionnaire spanned from December 16, 2022, to April 25, 2023. During this period, a stratified sampling approach was employed across tertiary hospitals, secondary hospitals, and primary healthcare institutions. Simultaneously, questionnaires were distributed to physicians from various regional healthcare institutions, ensuring the diversity and validity of the sample. Ultimately, a total of 193 questionnaires were collected, of which 160 were deemed valid, resulting in an effective response rate of 82.9%. The number of collected questionnaires was 26.6 times the number of latent variables.

3.2. Sample Statistical Results

The participants in this survey study were limited to physicians who have experience using electronic medical records. The statistical results from the basic information section of the sample reveal the distribution characteristics of the physician sample group, as shown in Table 2. It is evident that the age distribution of the sample primarily falls between 26 and 50 years, with a gender ratio that is normal. The physicians represent a variety of tertiary hospitals, secondary hospitals, and primary healthcare institutions, as well as diverse departmental categories.

Table 1
Questionnaire on electronic medical records

Dimension	Question Identifier	Question
Willingness to Share (WS)	SA1	I am willing to share patient diagnosis information with other medical institutions.
	SA2	I believe that sharing electronic medical records between different institutions is better than each managing them separately.
Privacy Protection (PP)	PP1	I am not concerned about patient information stored in the electronic medical record system being easily stolen.
	PP2	I trust the case-sharing system's ability to protect patient information.
	PP3	Sharing electronic medical records will not leak patient privacy.
Promptness (PT)	PT1	Patient diagnosis information can be promptly uploaded to the electronic medical record sharing platform.
	PT2	Patient information can be quickly published after I click the upload button.
	PT3	The electronic medical record sharing platform can update patient visit information from other medical institutions in a timely manner.
Perceived Easiness (PE)	PE1	The user interface of the electronic medical record sharing platform is user-friendly, and the function modules are clear.
	PE2	On the electronic medical record sharing platform, the diagnosis and treatment information of patients in other institutions is easy for me to read.
	PE3	I can easily find the necessary patient health information in the system during the treatment process.
Accessibility (AC)	AC1	Accessing data through permission can waste my working time.
	AC2	Some fields in patient records may be difficult to understand by different doctors.
Data Availability (DA)	DA1	If the structure of electronic medical records from other institutions differs from that of my hospital, it will be difficult for me to input the patient's health information into our electronic records.
	DA2	I cannot fully trust the medical data collected by medical instruments from other institutions in the patient's electronic medical record.
	DA3	Different formats of electronic medical records from various institutions increase the difficulty of merging patient health information.
Perceived Usefulness (PU)	PU1	Electronic medical records accelerate the efficiency of sharing patient condition information among doctors, making my work easier.
	PU2	Shared electronic medical records are more valuable in use than the previous paper records of patients.

3.3. Structural Equation Analysis

This survey study focused exclusively on physicians who have utilized electronic medical records (EMRs). The statistical results from the basic information section of the sample reveal the distribution characteristics of the physician sample group, as shown in Table 2. It is evident that the age distribution of the sample primarily falls within the range of 26 to 50 years. The gender ratio is balanced, and the physicians are drawn from tertiary hospitals, secondary hospitals, and primary healthcare institutions, representing a diverse array of medical specialties.

3.3.1. Model Measurement

When employing the Partial Least Squares (PLS) method for analysis, it is essential to validate the relationships between latent variables and observed variables. If these relationships are unclear, the explanatory power of the latent variables regarding the observed variables will be constrained, leading to substantial discrepancies between the model results and actual outcomes. To mitigate this issue, it is crucial to ensure that the relationships between latent variables and observed variables are clear and reliable. The

Fornell-Larcker criterion provides a reasonable basis for assessing the reliability and validity of structural equation models [14]. Specifically, when the Composite Reliability (CR) exceeds 0.7 and the Average Variance Extracted (AVE) is greater than 0.5, the model demonstrates high reliability and is acceptable. The Composite Reliability and Average Variance Extracted values for the measurement items in this study are presented in Table 3. In this research, all Composite Reliability values are above 0.7, and all AVE values exceed 0.5, with the maximum value indicating compliance with the Fornell-Larcker criterion, thereby demonstrating that the scales possess adequate convergent validity.

The aforementioned criteria can also be utilized to examine whether observed variables are influenced by other unrelated latent variables. If the AVE of an observed latent variable is greater than the square of the correlation coefficients of all other latent variables, the structure exhibits high discriminant validity. The AVE values among all latent variables and the squared correlation coefficient matrix of all other latent variables in this study are shown in Table 4. The results indicate that the minimum value on the diagonal exceeds all non-diagonal elements, confirming that the scales

Table 2

Basic information of the sample

Item	Option	Number	Percentage
Age	26~30	32	20.0%
	31~40	53	33.1%
	41~50	40	25.0%
	Over 50	35	21.9%
Gender	Male	84	52.5%
	Female	76	47.5%
Hospital Level	Secondary Hospital	58	36.3%
	Primary Healthcare Institution	25	15.6%
	Tertiary Hospital	77	48.1%
Department Type	Pediatrics	13	8.1%
	Auxiliary Examination Department	17	10.6%
	Gynecology	26	16.3%
	Internal Medicine	35	21.9%
	Other Specialty Departments	20	12.5%
	Surgery	49	30.6%

Table 3

Convergent validity

Variable	CR	AVE
AC	0.903	0.869
DA	0.846	0.757
EZ	0.921	0.860
PT	0.958	0.920
SA	0.893	0.902
SF	0.920	0.797
PU	0.791	0.825

employed in this research demonstrate good discriminant validity.

3.3.2. Structural Model

The primary objective of the model analysis is to assess the multiple determination coefficient R^2 of the endogenous latent variables and the path coefficients among these variables. The research findings indicate that higher R^2 values suggest greater acceptability of the model. Different research fields establish varying thresholds for acceptable R^2 values [16]. Generally, an R^2 value greater than 0.4 is considered to indicate strong explanatory power, thereby rendering the model acceptable.

The structural analysis results of this study are illustrated in Figure 2. The perceived usefulness, perceived ease of use, and willingness to share all exceed the 40% threshold: perceived usefulness is 91.3%, perceived ease of use is 61.9%, and willingness to share is 66.7%. Among the path coefficients of different influencing factors, all paths exhibited statistically significant p values below 0.01, with the exception of the paths from accessibility to perceived ease of use and from perceived ease of use to perceived usefulness.

4. Model Result

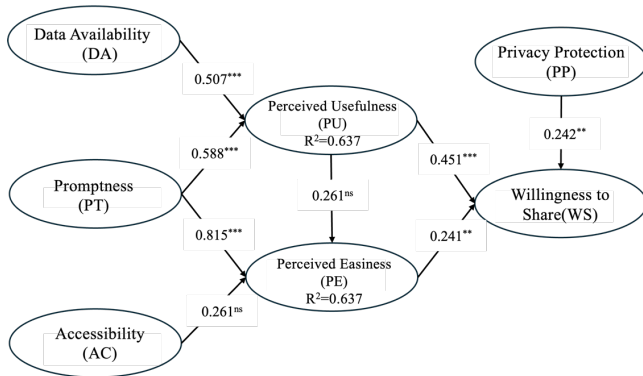
The path results obtained from the Partial Least Squares (PLS) analysis of the proposed model are illustrated in Figure 2. The results indicate that, except for hypotheses H3 and H8, all other hypotheses demonstrate significant support.

The lack of support for hypothesis H3 suggests that the perceived ease of use has a limited impact on perceived usefulness within the hierarchical diagnosis and treatment system. This indicates that the physician group has a clear understanding of perceived usefulness and does not equate the usefulness of electronic medical records (EMRs) solely with their manual or observational convenience. In comparison to perceived ease of use, perceived usefulness—referring to the added value derived from patient health data and consultation efficiency obtained through EMR sharing—emerges as the most significant factor influencing physicians' willingness to share EMRs.

Furthermore, the capacity of the EMR sharing system to protect patient health information privacy also has a significant positive impact on sharing willingness. This underscores the importance of privacy protection for the physician group, reflecting the professional ethics of most physicians. Perceived ease of use directly influences sharing willingness positively, indicating that physicians also consider the operational convenience when sharing EMRs. The lack of support for hypothesis H8 suggests that the convenience of accessing patient information within the hierarchical diagnosis and treatment system has a limited effect on perceived ease of use. Based on the implications of convenience in accessing information and specific measurement issues, two inferences can be drawn: first, the ease of accessing patient health information under the current EMR sharing system is relatively high, indicating a degree of maturity in this aspect; second, the impact of physicians' access to EMR permissions on perceived ease of use is minimal.

Table 4
Discriminant validity

	AC	DA	PE	PP	PT	SA	PU
AC	0.932						
DA	-0.241	0.870					
PE	-0.205	0.647	0.927				
PP	-0.266	0.423	0.603	0.893			
PT	-0.201	0.650	0.823	0.595	0.958		
SA	-0.242	0.659	0.731	0.615	0.792	0.950	
PU	-0.199	0.857	0.762	0.504	0.877	0.757	0.881

**Figure 2:** Results of the structural equation model analysis. Note: *** indicates $p < 0.001$, ** indicates $p < 0.01$, * indicates $p < 0.05$, and ns indicates not significant.

5. Conclusions

Enhancing the capacity for monitoring social health status and shifting medical interventions from treatment to prevention is an inevitable trend. The gradual implementation of the hierarchical diagnosis and treatment system, along with the continuous optimization of electronic medical records (EMRs), is accompanied by concerns regarding data privacy and data quality in the era of big data [40]. The design, implementation, and utilization of EMR systems involve hospitals, physicians, and the management of EMR information systems. Based on the context of the hierarchical diagnosis and treatment system, this paper empirically analyzes the factors influencing physicians' willingness to use EMRs. In this context, we propose the following recommendations from the stakeholders' perspective, based on the research findings, to promote the wider application and effective use of EMRs by physicians within the hierarchical diagnosis and treatment system.

5.1. Focus on Optimizing the Cross-level Diagnostic Function of Health Information in EMRs

When optimizing the EMR sharing system under strict cost constraints, the primary focus should be on the value of EMR consultations rather than other goal-oriented objectives. Strengthening the design and optimization of cross-level diagnostic functions within the EMR system will

enable physicians to conveniently access and analyze patient health information from other hospitals. By integrating and presenting key information, such as historical medical records, test results, and diagnostic notes from different hospitals, we can assist physicians in making comprehensive diagnostic and treatment decisions. Moreover, the cross-level diagnostic function should support information sharing and communication across hospitals and departments, facilitating the rational allocation of medical resources and smooth patient consultations. Promoting interoperability involves establishing unified data standards and formats, creating shared platforms or interfaces to enable the implementation of cross-level diagnostic functions. Additionally, enhancing integration with other medical information systems (such as laboratory and imaging systems) will achieve the fusion and comprehensive analysis of multimodal data, thereby improving diagnostic accuracy and efficiency.

5.2. Strengthening Privacy Protection and Data Security of EMRs

Information system managers should develop and enforce stricter privacy protection policies to ensure physicians' recognition of the privacy protection features of the EMR system. This includes enhancing data encryption and access control measures to ensure the security and privacy of patient data. Furthermore, establishing monitoring and audit mechanisms will help promptly identify and address potential data security issues, thereby enhancing physicians' trust and confidence in the system. Finally, given that interview data indicate a potential evolution of patient privacy concerns into doctor-patient conflicts, hospitals should leverage social outreach efforts to reassure patients about the protection of their sensitive health information stored in health information systems. This will enable physicians to use patient health information with greater confidence, alleviating any concerns.

5.3. Coordinating the Semantic and Structural Design of Cross-level and Cross-hospital EMR Data

The sharing of EMRs within the hierarchical diagnosis and treatment system needs to consider the differences in formats among various hospitals within the medical alliance, as well as discrepancies in medical equipment and data entry structures. It is essential to establish standardized data

collection and entry processes to minimize errors and omissions. Strengthening data monitoring and quality assessment mechanisms will allow for the timely identification and correction of data anomalies and inaccuracies. Enhanced collaboration with medical technology departments, such as laboratories and examination departments across medical institutions, is crucial. Establishing unified standards and specifications for cross-hospital EMR structural design will ensure consistency in data exchange and sharing among hospitals. These standards should encompass data formats, coding systems, and naming conventions, enabling compatibility and interoperability of EMR data across different hospital systems.

5.4. Improving System Interface and User Experience

In the current iteration of graphical user interface design, many EMR sharing systems in medical institutions exhibit certain outdated design elements. For instance, some operating systems are still based on Windows 7, and the user interfaces remain traditional. It is essential to optimize the system interface design to make it concise, intuitive, and easy to navigate and operate. Adopting layouts that align with physicians' habits and interface design principles will provide personalized EMR operation options suitable for individual physicians. This allows healthcare personnel to quickly input case details based on their department, diagnostic conditions, and preferred terminology, thereby enhancing system adaptability. The rapidly developing auto-fill features in recent years also reduce cumbersome operations and repetitive inputs, providing a quick and convenient method for health data entry and access.

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