

## Article

# A Multimethod Approach for Healthcare Information Sharing Systems: Text Analysis and Empirical Data

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**Abstract:** This paper provides empirical evidence using two studies to explain the primary factors facilitating electronic health record (EHR) systems adoption through the lens of the resource advantage theory. We aim to address the following research questions: What are the main organizational antecedents of EHR implementation? What is the role of monitoring in EHR system implementation? What are the current themes and people's attitudes toward EHR systems? This paper includes two empirical studies. Study 1 presents a research model based on data collected from four different archival datasets. Drawing upon the resource advantage theory, this paper uses archival data from 200 Texas hospitals, thus mitigating potential response bias and enhancing the validity of the findings. Study 2 includes a text analysis of 5154 textual data, sentiment analysis, and topic modeling. Study 1's findings reveal that joint ventures and ownership are the two main enablers of adopting EHR systems in 200 Texas hospitals. Moreover, the results offer a moderating role of monitoring in strengthening the relationship between joint-venture capability and the implementation of EHR systems. Study 2's results indicate a positive attitude toward EHR systems. The U.S. was unique in the sample due to its slower adoption of EHR systems than other developed countries. Physician burnout also emerged as a significant concern in the context of EHR adoption. Topic modeling identified three themes: training, healthcare interoperability, and organizational barriers. In a multimethod design, this paper contributes to prior work by offering two new EHR antecedents: hospital ownership and joint-venture capability. Moreover, this paper suggests that the monitoring mechanism moderates the adoption of EHR systems in Texas hospitals. Moreover, this paper contributes to prior EHR works by performing text analysis of textual data to carry out sentiment analysis and topic modeling.

**Keywords:** electronic health record (EHR); joint venture; ownership; text analysis



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## 1. Introduction

The confluence of the COVID-19 pandemic and economic and sociopolitical disruptions has significantly impacted hospitals' operations and financial performance in the United States [1]. The increasing pressures on hospitals to provide quality patient care amidst a challenging and dynamic environment have highlighted the critical role of knowledge information management systems in hospital management [2]. Hospitals need robust information management systems to avoid suboptimal decision-making, reduced operational efficiency, and (in some cases) bankruptcy. These dire financial outcomes are evidenced by the unprecedented number of hospital bankruptcies in recent times [3]. Therefore, investment in robust knowledge information management systems is imperative for

hospitals to improve their decision-making capabilities and ensure long-term sustainability in these trying times. There is a growing concern regarding sustainability goals [4,5].

### *1.1. Healthcare Spending and Financial Pressures*

U.S. healthcare spending reached USD 4.1 trillion in 2020 and accounted for 17.9% of the Gross Domestic Product. Healthcare spending markedly increased due to insurance coverage enacted through Obamacare and the high growth rates of retail prescription spending. In 2020, healthcare expenditure increased to over USD 4 trillion, with healthcare expenditure per person being USD 10,202 annually [6]. Hospital care costs make up the most significant part of that healthcare spending, accounting for about 33% of the entire spending; the American Health Care Act (AHCA) passed by the U.S. House of Representatives will reduce federal spending on Medicaid by more than USD 834 billion over the next ten years. As a result, hospitals face financial distress while confronting media and public scrutiny of health organizations' commitment to providing high healthcare standards. This pressure has resulted in the closure of various hospitals and a proliferation of mergers and acquisitions in the sector [7,8]. The increased mergers and acquisitions have resulted in the Federal Trade Commission's (FTC) aggressive antitrust enforcement.

Research shows that hospitals cannot depend on government grants or endowments to subsist and need to strive to be self-sufficient and efficient to meet their financial goals [9]. Simultaneously, during the period from 2013 to 2017, there occurred a push in the healthcare industry to adopt electronic health record (EHR) systems and advance their utilization. EHR systems are real-time, digital patient-centered records that make data available immediately and securely to authorized users [10].

U.S. hospitals' financial liquidity predicament coincides with more significant incentives to embrace emerging technologies and innovations. No singular technology has received greater public and media attention than EHR implementation. An EHR is defined as a complete digital health record maintained by a healthcare provider and is intended to be person-centric [11]. EHR systems play a substantial role in healthcare knowledge management by centralizing accessible information and facilitating knowledge sharing and collaboration for continuous healthcare improvement.

### *1.2. Adoption of Electronic Health Records (EHR) and Healthcare*

The adoption of EHR systems is vital to sustaining the efficiency and effectiveness of the healthcare system through its moderating effects on the organizational and environmental factors affecting a hospital's operations [12]. Designing the EHR system to have enhanced trust requirements increases participation by doctors and patients. Physician-user interaction has been acknowledged as beneficial in offline and online consultations, and EHRs make this process more beneficial [13]. Previous research showed that the usability of electronic personal health records improves physicians' confidence in their patients' capability to manage their health [14].

EHR implementation has a considerable impact on information-sharing capabilities in healthcare management [15]. Information quality is a critical capability in organizations [16]. EHR systems digitalize information and knowledge management, making care delivery effective and efficient [17]. A well-developed information sharing system plays an important role in patient care when multiple healthcare providers are involved in care delivery, which requires real-time access to patient information [18]. Healthcare organizations heavily rely on information systems such as EHRs to offer the best healthcare delivery [19]. Thus, EHR implementation is the first and the main step toward improving healthcare, including a high quality of patient care [20]. Suboptimal information sharing practices create multiple versions of data, which can slow patient care during an emergency. Moreover, healthcare knowledge management would be ineffective in storing and retrieving information. EHR systems are an important improvement in healthcare, especially in places like Texas, which have no Medicaid expansion. EHR systems help collect patient data, significantly reducing healthcare disparities (e.g., see [21]).

### 1.3. Adoption Challenges and Disparities in EHR Implementation

The Health Information Technology for Economic and Clinical Health Act of 2009 resulted in hospitals becoming motivated to implement EHR systems. However, EHR systems are not fully employed in hospitals due to barriers, which divides hospitals into those with partial EHR and full EHR implementations. These disparities in EHR utilization reflect differences in the level of care provided by hospitals, with those with comprehensive EHRs better equipped to offer quality care than those with primary or partial EHRs. Healthcare providers' recording of notes and treatments remains a significant void in EHR implementation. The potential of EHRs may be uneven and not fully realized in terms of U.S. hospitals' financial and operational performance, contributing to a digital divide. The potential benefits of EHR can best be realized when patients and providers consistently use personal health records through electronic portals [22]. The study of patient behaviors and organizational factors is essential to addressing technological solutions to healthcare [23].

### 1.4. Assessing EHR Implementation

Survey data are used to evaluate both the user experience and the impact of EHRs on organizational changes [24]. For example, Ahmadi et al. [25] demonstrated that implementing hospital information systems, including EHR adoption, remains a daunting challenge in the U.S. healthcare system. Their investigation systematically examined the technological, organizational, and environmental factors that impact healthcare information system adoption. However, there is still a need to introduce EHR system enablers and moderators. Thus, we address the following questions: What are the main organizational antecedents of EHR implementation? What is the role of monitoring in EHR systems implementation? and What are the current themes and people's attitudes toward EHR systems?

In a multimethod design, this paper contributes to prior work by offering two new EHR antecedents: hospital ownership and joint-venture capability. Moreover, this paper suggests that the monitoring mechanism moderates the adoption of EHR systems in Texas hospitals. Drawing upon the resource advantage theory, this paper employs archival data from 200 Texas hospitals, thus mitigating potential response bias and enhancing the validity of the findings. Moreover, this paper contributes to prior EHR works by performing text analysis of 5154 textual data to carry out sentiment analysis and topic modeling. The results indicate a positive attitude towards EHR systems, while physician burnout emerges as a significant concern in EHR adoption. Topic modeling identifies three main concepts: training, healthcare interoperability, and organizational barriers.

The rest of this paper is organized as follows. The following section presents theoretical information on the characteristics and constructs used in the modeling framework related to hospitals. The resource advantage theory guides the framework for the viability of hospitals to build and sustain a competitive advantage. In Section 4, archival data from 200 Texas hospitals are explained and analyzed using regression analysis including text analysis. Finally, this paper concludes with contributions and future research directions in Section 5.

## 2. Theoretical Foundation

Similar to the relational view [26], the resource advantage (RA) theory explains how firms' resources creating values can impact performance [27]. Sustained superior performance happens when a company maintains its competitive edge through its resource advantage, despite competitors' attempts to undermine it. This implies that the firm's resources provide an ongoing competitive advantage, allowing it to maintain a strong position in the market. Despite rivals' actions to compete, the company's comparative advantage in resources allows it to maintain its competitive edge, resulting in continued performance success [28].

### *2.1. Resource Advantage Theory and Competitive Advantage*

Conceptually, the RA theory has identified seven different resources: physical, financial, organizational, informational, legal, human, and relational [29]. Each of these seven types of resource contributes uniquely to a firm's ability to innovate, adapt, and outperform rivals, thereby enhancing its long-term success and profitability. Physical resources contribute to operational capabilities. Financial resources enable growth. Organizational resources facilitate efficiency and adaptability. Informational resources provide business intelligence. Legal resources mitigate risks. Human resources nurture valuable networks. Relationship resources strengthen a firm's competitive advantage [29]. These resources enable the benefits of EHR systems to be realized in a shorter time horizon, although this time frame will vary by hospital.

In the RA theory, assets may be tangible or intangible, and any identifiable assets should be leveraged to result in efficient and effective value in the marketplace by enhancing the quality of the goods and services produced [30]. The theory posits that each firm in the marketplace has unique resources that produce more value at less cost and that this combination gives them a competitive advantage. RA theory posits that innovation is both proactive and reactive. Firms learn through competition due to feedback from relative performance to signal their relative market position, which in turn signals relative resources. Theoretically, businesses can achieve and sustain a competitive advantage resulting in superior performance by creating and utilizing unique combinations of heterogeneous and imperfect resources. This allows them to gain an edge in the market, maintain their position over time, and achieve long-term success [31]. Because joint ventures are partnerships between hospital systems, collaboration across operations invariably requires interoperability across information systems. Based on the RA theory, this paper posits that joint ventures and ownership can be viewed as resources that create advantages in adopting EHR systems, resulting in improved financial performance.

### *2.2. Research Limitations and Gaps in Understanding Successful EHR Adoption*

The existing literature on successful EHR implementation lacks generalizability across different hospital settings, as organizational structures, resource availability, and regulatory environments vary significantly [12]. Research should consider the unique needs and priorities of different healthcare stakeholders. The predictor variables included in this study are specifically selected to provide a more holistic approach to the study of EHR implementation. Joint ventures are a game changer for many hospitals and often provide the necessary leadership to achieve long-term success in EHR implementation [32]. Hospital monitoring is often overlooked as an essential practice in providing access to comprehensive and reliable data to assess and track the impact of monitoring strategies on EHR success. Another limitation of previous studies is the underestimation of the role of for-profit and not-for-profit organizations. These types of organizations differ due to their innovation, agility, financial incentives, and strategic priorities [33,34]. These variables affect the dynamic nature of healthcare as well as the evolving technology landscapes that enhance the long-term sustainability of EHR.

### *2.3. Complexity of EHR Implementation*

The implementation of EHRs is a complex undertaking. As per the Department of Health Information Technology, an EHR is a digital version of a patient's paper chart. EHR systems are real-time, patient-centered records that make information available instantly and securely to authorized users. While an EHR contains patients' medical and treatment histories, it includes a broader view of a patient's care, such as vaccination records, patient compliance history, and proactive management of preventable diseases. It can be used for medical research [35]. EHR adoption can be classified into three categories: no, partial, and comprehensive. Not all hospital units may adopt an EHR system simultaneously due to various factors, including logistical challenges, resource constraints, and differing priorities

within the organization. For example, there is a learning curve that may take time for all units to fully embrace the full potential of EHRs.

Comprehensive adoption is defined as the adoption of EHRs across most clinical units in a hospital. A partial adoption is the adoption of EHRs in one or a few hospital units [36]. While partial EHR adoption is better than paper records, the full benefits of EHRs are realized when they are comprehensively adopted. Previous research has investigated several factors that facilitate the successful adoption of EHR systems. However, an analysis of the literature reveals that the potential impact of joint ventures, ownership, and monitoring as critical factors in EHR adoption has yet to be explored.

#### 2.4. For-Profit and Not-for-Profit Classification and EHR Implementation

A principal factor in organizational performance is ownership classification. Ownership of a hospital is often categorized as either “for-profit” or “not-for-profit”. The goal of for-profit hospitals is to optimize profitable strategies to maximize financial gain. Therefore, different business approaches result in their medical services varying considerably. The rationale for selecting the predictor variable regarding ownership classification is that “for-profit” and “not-for-profit” healthcare organizations often have distinct organizational cultures and values that shape their approach to technology adoption and implementation. For-profit organizations may prioritize innovation, competition, and market-driven strategies, while not-for-profit organizations may emphasize collaboration, service excellence, and social responsibility. These cultural differences can influence decision-making processes, project management approaches, and stakeholder engagement strategies during EHR implementation.

For-profit hospitals are more prone to deliver expensive and varied treatment options to a patient than nonprofit hospitals. Although any organization’s goal is profitability, non-profit hospitals tend to put social services first when balancing it against profit-making goals. Moreover, the for-profit hospital is answerable to its shareholders and board of directors, prioritizing profit-making as its bottom-line objective. For-profit hospitals prioritize maximizing financial gain [37]. EHR systems can help hospitals streamline administrative processes, reduce medical errors, and improve patient outcomes, ultimately leading to cost savings and increased revenue [35]. Therefore, for-profit hospitals have more financial resources to invest in technology, including EHR systems [38]. For-profit hospitals are strongly incentivized to implement EHR systems because they can increase efficiency and cost savings in the long run [39]. EHR systems can help hospitals streamline administrative processes, reduce medical errors, and improve patient outcomes, ultimately leading to cost savings and increased revenue. Non-profit hospitals can be subject to more regulatory and bureaucratic hurdles that can slow the implementation of new technology [40]. Therefore, our hypothesis is as follows:

**Hypothesis 1 (H1).** *The type of hospital ownership correlates with the adoption of EHR systems, in that for-profit hospitals are more likely to fully implement EHR systems than not-for-profit hospitals.*

#### 2.5. Joint-Venture Hospitals and EHR Implementation

Joint ventures allow healthcare organizations to pool their resources [41], including financial capital, expertise, technology, and infrastructure [42,43]. The rationale for selecting the predictor variable regarding joint ventures is that joint-venture collaboration enables partners to access resources that may not be available independently, facilitating the development of new services, facilities, or technologies [44,45]. Past work has shown that joint-venture hospitals provide more clinical services and lower debt [44]. By combining the specialized skills and knowledge of multiple organizations, joint ventures can create synergies that lead to innovative solutions and improved patient care [46]. For example, partnerships between hospitals and research institutions can accelerate the translation of scientific discoveries into clinical practice [47].

Hospitals are often intertwined with other healthcare, religious, or social institutions which require a comprehensive analytical solution, particularly in location–allocation decision-making, demanding a collaborative involvement [48]. Increasingly, many hospitals have joint ventures with other institutions or healthcare networks. A hospital that is a joint venture can achieve economies of scale in procurement, medical and diagnostic equipment, personnel, and market reach, availing them of better bargaining power than their counterparts. Moreover, joint-venture hospitals have been shown to reduce costs while maintaining a high quality of care [49]. Through joint-venture capability, hospitals collaborate with one or more other organizations in projects or businesses to improve their profits.

Risks and responsibilities are shared among partners in joint ventures. When hospitals employ a joint-venture approach, they will have access to shared resources by which costs are minimized and bargaining power is increased [50]. With joint ventures, hospitals can be more efficient by taking advantage of shared resources, financial and business learnings, and relationships [51]. When it comes to EHR implementation, there is a high likelihood for joint-venture hospitals to manage unexpected adoption challenges by shared prior business learning from other parties. Joint-venture hospitals can avoid their partners failures and mistakes during a practice implementation. Moreover, in joint ventures, shared financial resources empower hospitals to mitigate budget limitations and lack of financial line security [52]. Joint-venture hospitals can improve their financial resources to facilitate EHR implementation, which can result in better financial performance [53].

Joint-venture hospitals can better negotiate with EHR vendors and other stakeholders due to their financial power, which can result in more favorable conditions for EHR implementation. For example, the average debt percentage is lower for joint-venture hospitals (40%) compared with non-joint-venture hospitals (44%) [54]. Compared to traditional hospitals, joint-venture hospitals are more open to innovation and change by which they become more receptive to EHR implementation. An openness to innovation and changes can increase EHR adoption rates and improve healthcare outcomes. As hospitals are part of the e-healthcare system, their success in maintaining EHRs can facilitate proposals to develop intelligent e-healthcare systems. Joint-venture hospitals can contribute to developing these systems by sharing their EHR data and resources with other healthcare institutions, leading to improved collaboration and coordination in healthcare delivery. Thus, we make the following hypothesis:

**Hypothesis 2 (H2).** *Joint-venture capability positively relates to the adoption of EHR systems.*

### *2.6. Hospital Monitoring and EHR Implementation*

Hospitals monitor their processes by conducting regular internal surveys of quality and safety. The rationale for selecting the predictor variable regarding hospital monitoring is that monitoring provides oversight, support, and accountability that ensures that EHR systems and practices align with regulatory guidelines and industry standards. Thus, monitoring reduces the risk of legal and financial penalties associated with non-compliance. A hospital conducting regular surveys better understands its processes and weaknesses. This information can identify operational gaps and correct problems more expediently, contributing to increased operating margins. Hospitals are eyeing programs to reduce costs. Past works offered significant correlations between IT availability and complications [55,56] and better performance [57,58]. Joint-venture hospitals can monitor and evaluate their EHR implementation by conducting regular internal surveys of quality and safety [59]. Monitoring can identify potential improvements and address any issues that may arise [60].

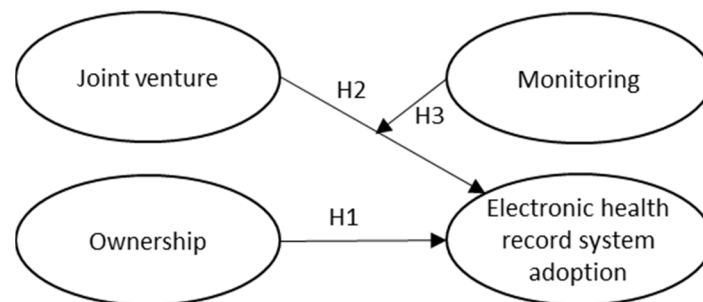
Effective monitoring can also build trust and collaboration between members and improve the relationship between joint ventures and EHR adoption [61]. Regular internal surveys of quality and safety can help joint-venture hospitals to identify potential improvements in EHR implementation. With staff and patient feedback, joint-venture hospitals can identify usability issues and interoperability can be maximized [62]. Feedback can

be used to make necessary adjustments to the EHR system, which can improve adoption. Joint-venture hospitals offer a range of benefits that can help to overcome common barriers to EHR implementation. Effective monitoring through regular internal surveys of quality and safety can improve the relationship between joint ventures and EHR adoption.

**Hypothesis 3 (H3).** *Monitoring strengthens the relationship between joint-venture capability and the adoption of EHR systems.*

### 3. Methodology

This paper uses regression analysis in Study 1 to examine the hypothesized relationships in the research model shown in Figure 1. The data for this analysis have been collected from hospitals located in Texas.



**Figure 1.** Research model.

#### *Sample, Data, Variables*

To test the hypotheses, we collected data from 200 hospitals in Texas from four separate data sources: the American Hospital Directory (AHD), the American Hospital Association (AHA), the Centers for Medicare and Medicaid Services database, and the Office of Management and Budget (OMB). The AHD and OMB provided general demographic data, the CMS provided quality/regulation data, and the AHA provided organizational and EHR data.

EHR system adoption was the dependent variable. We operationalized EHR adoption using a two-point scale developed by the AHA. The AHA collects survey data annually from U.S. hospitals and assigns EHR scores based on responses regarding the extent of EHR adoption. EHR adoption can be classified into the following two categories—low and high levels of EHR adoption. Hospitals with “low EHR”, “no EHR”, or “partial EHR” are grouped. A “partial” adoption refers to the adoption of EHR in some hospital units, which shows some implementation of EHRs. Moreover, the “no EHR” category comprises a small percentage of the data. A “comprehensive” implementation of EHRs, or a high level of EHR adoption, is defined as the adoption of EHRs across all significant clinical units in the hospital. In our study, we considered EHRs a binary variable, with the two categories being referred to as either “partial” or “full” EHR implementation. Each category included 100 hospitals.

The independent variables are joint venture and ownership. The joint-venture variable is a binary indicator. A value of “0” or “No” indicates the absence of joint-venture capability, while a value of “1” or “Yes” confirms its existence. The American Hospital Association ([www.aha.org](http://www.aha.org), accessed on 1 January 2024) provides joint-venture data. Similarly, the ownership of a hospital is classified as a binary variable, with two categories: “for-profit” or “not-for-profit”. Hospitals’ regular internal surveys capture the moderator variable called monitoring. This variable is binary, where a value of “0” or “No” denotes the absence of monitoring, and a value of “1” or “Yes” confirms its presence. Monitoring data can be accessed through the Centers for Medicare and Medicaid website ([www.cms.gov](http://www.cms.gov), accessed on 1 January 2024).

In EHR systems, organizational size is the primary control variable to include, with possible impacts on outcomes. The number of beds can capture organizational size. In other words, the size of a hospital can be denoted by its number of beds. Hospitals with more beds can achieve more significant economies of scale than hospitals with fewer beds. Larger hospitals can have an advantage due to economies of scale, facilitating the efficient utilization of available infrastructure, resources, and equipment to gain a competitive advantage.

#### 4. Results

The sample satisfied the regression analysis assumptions, e.g., linearity, independence, homoscedasticity, normality, and no multicollinearity [63,64]. Table 1 provides information on the correlation between the different variables included in this study. Three regression models were considered to provide more details about the hypothesized relationships. The R<sup>2</sup> value measures the proportion of variance in the outcome variable explained by the model’s predictor variables [65]. This paper assessed the goodness of fit for each model by examining the R<sup>2</sup> value. A higher R<sup>2</sup> indicates a better fit between the predictor and outcome variables. We conducted a multiple regression analysis to test the hypothesized relationships between the predictor variables (independent variables) and the outcome variable (dependent variable). The results of the analysis are presented in Table 2.

**Table 1.** Correlations of model predictor variables.

	EHR	Ownership	Joint Venture	Monitoring	Number of Beds
EHR	1	−0.353 **	0.382 **	0.157 *	0.232 **
Ownership	−0.353 **	1	−0.280 **	−0.060	−0.272 **
Joint venture	0.382 **	−0.280 **	1	0.226 **	0.254 **
Monitoring	0.157 *	−0.060	0.226 **	1	0.194 **
Number of beds	0.232 **	−0.272 **	0.254 **	0.194 **	1

\*\* The correlation is significant at the 0.01 level. \* The correlation is significant at the 0.05 level.

**Table 2.** Regression results.

	Model	B	Error	β	t	p
1	(Constant)	0.396	0.046	-	8.534	<0.001
	Number of beds	0.001	0.000	0.232	3.352	0.001
2	(Constant)	0.582	0.076	-	7.627	<0.001
	Number of beds	0.000	0.000	0.091	1.361	0.175
	Ownership	−0.272	0.074	−0.247	−3.659	<0.001
	Joint venture	0.370	0.085	0.290	4.330	<0.001
3	(Constant)	0.583	0.084	-	6.964	<0.001
	Number of beds	0.000	0.000	0.086	1.288	0.199
	Ownership	−0.276	0.073	−0.251	−3.774	<0.001
	Joint venture	−0.129	0.207	−0.101	−0.623	0.534
	Monitoring	0.008	0.071	0.008	0.117	0.907
	Monitoring × Joint venture	0.572	0.223	0.424	2.566	0.011

Model 1 tests the possible effect of the number of beds on the outcome. The results showed that the number of beds positively correlates with EHR system adoption ( $B = 0.001$ ,  $p$ -value = 0.001, and  $R^2 = 0.054$ ). However, the model had a low coefficient of determination ( $R^2 = 0.054$ ), indicating that only 5.4% of the variance in EHR adoption could be explained by the number of beds alone. This suggests that other factors, beyond the number of beds, influence EHR adoption in the healthcare organization under study. Model 1 supports the statement that the number of beds is an important control variable to include in this study as it accounts for the size of the hospital and its operational capability.



Model 2's results confirm hypotheses 1 and 2, indicating the relevance of ownership and joint-venture status to EHR adoption in contemporary healthcare settings. In other words, H1 is supported ( $B = -0.272$ ,  $p$ -value  $< 0.001$ , and  $R^2 = 0.219$ ), revealing that for-profit hospitals (mean = 0.78, std = 0.4) are more likely to fully implement EHR systems than non-for-profit hospitals (mean = 0.39, std = 0.4). Similarly, H2 is supported ( $B = 0.370$ ,  $p$ -value  $< 0.001$ , and  $R^2 = 0.219$ ), underscoring that joint-venture hospitals (mean = 0.39, std = 0.49) are more likely to fully implement EHR systems than non-joint-venture hospitals (mean = 0.56, std = 0.49). Note that the number of beds is insignificant ( $B \sim 0.0001$ ,  $p$ -value = 0.175, and  $R^2 = 0.219$ ), which highlights that the control variable of number of beds does not play a predictive role in the presence of the key predictor variables included in this study. The interpretation of Model 2 is that it supports this study's novel contribution that joint-venture partnerships enhance the efficiency and effectiveness of EHR implementation and that for-profit organizations have a more successful culture to meet the challenges in addressing EHR implementation.

Model 3 evaluates the interaction effect of monitoring and joint-venture capability on adopting EHR systems. The analysis results indicated that monitoring positively contributes to the relationship between joint-venture capability and the adoption of EHR systems, providing support for H3 ( $B = 0.572$ ,  $p$ -value = 0.011, and  $R^2 = 0.248$ ). The regression coefficient for monitoring ( $B = 0.572$ ) was statistically significant at the 0.05 level ( $p$ -value = 0.011), indicating a solid positive moderating effect of monitoring on the relationship between joint-venture capability and EHR adoption. The coefficient of determination ( $R^2 = 0.248$ ) indicated that 24.8% of the variance in EHR adoption could be explained by the predictor variables in the model.

Model 3 contributes to the novel contribution of this study that postulates that joint-venture partners can enhance their ability to successfully implement and use EHR systems by incorporating monitoring practices into their joint-venture capability strategies. That is, the incorporation of monitoring practices fosters a culture of shared responsibility and mutual accountability among joint-venture partners. By establishing clear performance benchmarks and accountability mechanisms through monitoring, partners are incentivized to collaborate closely, align their efforts, and work towards common goals. This collaborative approach not only enhances the efficiency and effectiveness of EHR implementation but also strengthens the overall resilience and sustainability of the joint-venture partnership.

#### *Text Analysis: Study 2*

Machine learning perspectives can improve organizational performance [66,67]. In machine learning, tweet analysis can considerably impact EHR systems [68]. Healthcare decision-makers can evaluate the public perception and sentiment toward EHR system implementation [69]. Tweets represent real-time user feedback and experiences, providing valuable insights into the efficiency of EHR platforms from the perspective of both patients and healthcare professionals [70]. Tweet analysis can identify emerging concerns and issues in EHR systems from user and organizational perspectives [70]. Like other social media platforms, Twitter serves as a communication channel for healthcare organizations to provide health information and promote EHR adoption [71,72]. Tweet analysis helps policy-makers and healthcare administrators identify the challenges of EHR systems, contributing to better resource allocation [73].

Study 2's sample includes 5154 tweets containing "EHR", "adoption", and "implementation" posted from 1 January 2020 to 1 June 2023. The text analysis in this paper included three main stages. In the first stage, using the Python programming language, we cleaned data from retweets, non-English letters, URL and website links, and stop words (e.g., "the" and "we"). Moreover, the keywords ("EHR", "adoption", and "implementation") were removed. In data cleaning, we made all words and terms consistent by decapitalizing them [74]. Using the Natural Language Toolkit Python library, this paper utilized the Lemmatize method to reduce text complexity by converting all word cases to their root

(e.g., caring to care and studies to study) [75]. Due to the inaccuracy of the stemming technique (e.g., caring to car), it was excluded in the data cleaning in this paper [76].

In the second stage, we performed descriptive analysis, including n-gram analysis, word cloud, and sentiment analysis. Word cloud analysis is shown in Figure 2, highlighting interoperability and digitalization. Figure 3 presents a word cloud analysis of bigram in which physician burnout, information sharing, digitalization, quality, and cognitive workload are highlighted, which are supported by top bigrams given in Figure 4. United States is shown in the word cloud analysis. The healthcare system in the United States is often criticized for its inefficiency, with some describing it as a broken system [77]. Moreover, U.S. hospitals have been slow to adopt EHR systems [12]. Despite spending USD 4.1 trillion on healthcare in 2020, the U.S. ranks last in administrative efficiency and healthcare outcomes among high-income nations [78]. EHR systems have the potential to enhance this efficiency [79]. Using the TextBlob Python library, we did sentiment analysis, sometimes called opinion mining in natural language processing (NLP) techniques [80,81]. Figure 5 presents the results of the sentiment analysis, with an average of 0.27, indicating a positive attitude toward EHR implementation.



Figure 2. Word cloud analysis of unigrams.



Figure 3. Word cloud analysis of bigrams.

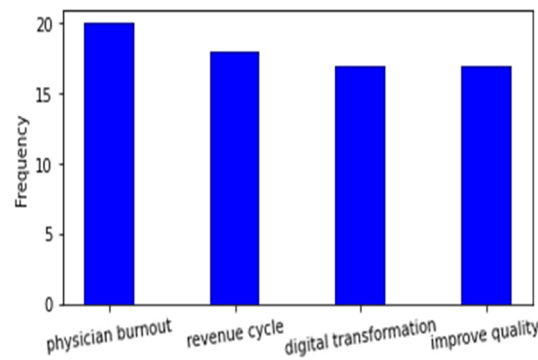


Figure 4. Top bigrams.

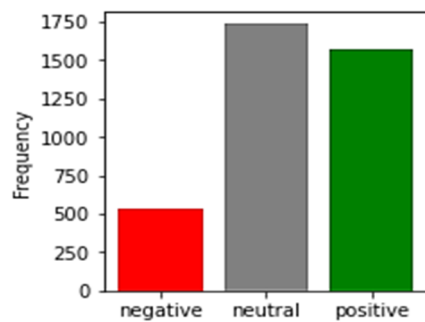


Figure 5. Sentiment analysis (mean = 0.271).

In the third step, we employed the latent Dirichlet allocation (LDA) algorithm for topic modeling [82]. Coherence score analysis was used to identify the optimal number of topics, which is three, with a score of 0.30 given in Figure 6. Three primary themes were identified in this study: training, healthcare interoperability, and organizational barriers, as shown in Figure 7. The initial focal point is on training, which emerges as a central and pivotal concept in EHR implementation, with the overarching goal of enhancing workflow efficiency and optimizing the usability of this cutting-edge digital technology within the healthcare setting. The second theme centers around the critical aspect of information flow. It is underscored by emphasizing healthcare interoperability to facilitate seamless data exchange and communication across diverse healthcare systems. The third topic delves into the multifaceted challenges and complexities associated with adopting EHR systems, shedding light on the intricate dynamics that impede successful integration and acceptance within healthcare institutions.

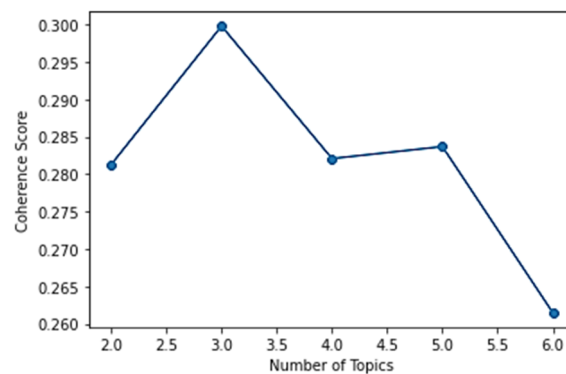


Figure 6. Coherence score analysis.



Figure 7. Identified topics.

## 5. Discussion

This paper fills an important gap in the existing literature as a pioneering effort in empirically assessing the adoption of EHR systems. This paper contributes to the literature on healthcare information systems in the following ways. Drawing upon the resource advantage theory, we developed a simple framework to investigate the relationship between EHR implementation levels and organizational factors. The empirical findings of Study 1 support the theoretical arguments of scholars (e.g., Hunt and Morgan [28]) who suggested that the interaction of different resources in a firm produces a competitive advantage and ultimately results in improved firm performance. They argued that companies can attain and maintain advantageous performance by utilizing and optimizing distinctive blends of diverse and partially movable resources [83].

The implementation of EHRs is anticipated to have a positive effect on financial performance. However, EHR implementation is complex, and its main enablers need more investigation. Hospitals are under increasing pressure from various healthcare organizations to allow access to their EHR system. Important drivers of EHR implementation are the support of clinical research, healthcare quality, and economic objectives. The resource advantage theory supports the implementation of EHRs as a means to create a competitive advantage, both in healthcare quality and economic efficiency. The results of Study 1 support hospital managers in strategically utilizing resources holistically to positively affect the operating margin and, ultimately, the hospital's sustainability.

Study 1 points to the concept of utilization. As the size of the hospital becomes larger, it has to become more efficient in utilizing existing resources. EHR is one of the means through which large hospitals can achieve optimal utilization of their existing resources. Third, it supports the ongoing trends of hospital mergers as a strategic mechanism for reducing hospitals' financial distress and impending closures. In 2023, there was a recorded frenzy of 65 hospital mergers and acquisitions throughout the U.S., and numbers will likely increase [84]. Technology giants like Amazon, Google, and Apple are now entering the healthcare field through patient records and turning patients into savvy healthcare consumers. Therefore, it becomes important for hospital executives to understand EHR systems and their existing resources.

The aim of Study 1 was to investigate the relationship between hospital ownership, joint-venture capability, and the adoption of EHR systems. Based on the hypotheses developed, it was found that there are significant correlations between these variables. In H1, for-profit hospitals are more likely to fully implement EHR systems compared with not-for-profit hospitals. Similarly, prior works suggest that for-profit hospitals have greater financial resources and are more likely to invest in EHR systems [38]. H2 stated that joint-venture capability positively relates to EHR implementation. Joint-venture hospitals have access to shared resources and expertise, which can increase the ability to adopt EHR systems. Joint ventures allow hospitals to pool their resources and share the costs of EHR implementation. H3 examined the moderating effect of monitoring on the relationship between joint-venture capability and EHR adoption.

This paper contributes to prior works by presenting empirical evidence of the relationships between hospital ownership, joint-venture capability, and EHR implementation. The findings suggest that hospital administrators should focus on increasing the resources, par-

ticularly not-for-profit hospitals, and prioritize monitoring to ensure EHR implementation. Moreover, this paper built on prior works by conducting a text analysis of 5154 textual data, which included sentiment analysis and topic modeling. The text analysis findings revealed a positive perception of EHR implementation, while physician burnout emerged as a concern in EHR adoption. Topic modeling identified three key themes: training, healthcare interoperability, and organizational barriers. These can be a focus for policy makers and healthcare administration to prepare organizations to adopt and implement any new healthcare practices.

#### *Limitations and Future Research*

Our findings include some research limitations which can be addressed in future research. These limitations are as follows. This paper focused only on a few variables which may influence EHR adoption due to limited access to data. Moreover, this paper used a cross-sectional design, which limits the ability to draw causal inferences of the hypothesized relationship. Future research can use a longitudinal design to examine changes in EHR adoption over time and identify the factors impacting changes. This paper used a sample of hospitals from a single U.S. state, which can limit the generalizability of the findings to other countries. Finally, our findings cannot be generalized to private practice, solo providers, or even rural doctors because they probably have a different set of challenges compared to big hospitals.

Further research is needed to replicate these findings in different contexts and explore whether cultural or institutional factors may influence the relationship between hospital ownership, joint-venture capability, and EHR adoption. Future research can use more objective measures of EHR adoption, such as data from EHR systems, to provide a more accurate picture of EHR adoption in hospitals. Moreover, future research can investigate the role of emerging technologies, such as the metaverse [85], in EHR systems. Finally, the unit of analysis is limited to the hospital level. As there are differences in admission processes, availability of resources, and treatment options between clinics, it would be interesting to expand the findings of this paper by analyzing small clinics.

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