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Hsun-Ming Lee

(Department of Information Systems and Analytics, Texas State University)

Peiqin Zhang

(Department of Information Systems and Analytics, Texas State University)

Jaymeen Shah

(Department of Information Systems and Analytics, Texas State University)

ABSTRACT

Patient satisfaction is perceived as a significant benefit of hospitals' investments in health information exchange (HIE). Successful implementation of HIE systems lead to increased organizational efficiency in hospitals and more likely to enable doctors and other staff members to better meet patient needs and expectations. This research draws upon system success theory to examine how HIE adoption affects patient satisfaction. In addition, this research investigates whether the relationship between HIE adoption and patient satisfaction is mediated by organizational efficiency. This is the first research study that draws upon system success theory to understand how HIE adoption affects patient satisfaction.

For this study, the dataset was developed by integrating data from the Healthcare Cost Report Information System and the Hospital Compare data from the Medicare.gov website. It contained data from 2,459 U.S. acute care hospitals. Regression models were used to empirically validate relationships between HIE adoption and patient satisfaction. A three-step analysis was used to test the mediation effect. Results of this study indicates that HIE adoption positively impacts hospital efficiency. In addition, hospital efficiency positively influences patient satisfaction. Furthermore, the results validate the mediation role of hospital efficiency and suggest that HIE adoption indirectly affects patient satisfaction through hospital efficiency. HIE adoption leads to healthcare information system success (organizational efficiency), which in turn increases patient satisfaction.

Keywords: Health Information Exchange, patient satisfaction, organizational efficiency

INTRODUCTION

Health information technologies (HIT) enable sharing of electronic patient health information between healthcare providers and provide access to patient health information to improve healthcare quality, efficiency, and safety. There is a significant need to use HIT in the realm of patient care (Coffetti et al., 2023). The Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009 was enacted to promote the adoption and meaningful use of HIT to reduce healthcare costs and improve quality of care. To achieve these goals, in 2009, the U.S. allocated more than \$30 billion and established the Office of National Coordinator for Health Information Technology (ONC) to coordinate development of HIT infrastructure and drive HIT adoption (Bui et al., 2018). It has been estimated that extensive use of HIT is likely to result in an annual reduction of \$371 billion in healthcare services costs (Hillestad et al., 2005). The HITECH Act included incentives to use Electronic Health Record (EHR) systems and Health Information Exchanges (HIE), which support exchange of patients' electronic health information. Use of HIE can improve healthcare quality and efficiency as well as coordination of patient care (Burde, 2011).

Due to the HITECH Act, there has been a significant increase in investment in health information exchange. HIE is a clinical HIT system, which enables reliable electronic exchange of clinical data among healthcare facilities, such as doctor offices, clinical laboratories, and hospitals (Jha et al., 2008; Miller & Tucker, 2014). Use of HIE allows healthcare providers to share patient medical records electronically and provides them with appropriate access to patient records (Bui et al., 2018). The focus of HIE is to enhance healthcare providers' access to patients' clinical data to improve coordinated patient care and efficiency of healthcare services across providers (Shapiro et al., 2011; Yaraghi et al., 2019). Providing better and efficient access to patients' data to healthcare providers enhances quality of patient care and reduces costs (Walker et al., 2005; McGlynn et al., 2003; Smith et al., 2005). HIE's positive effect on the quality of patient care, especially the chronically ill, is attributed to improved care coordination, communication and knowledge about patients, reduction in costs due to decrease in duplication of laboratory and radiology tests and services, and timely availability of patients' clinical data across the organizational boundaries of care providers (Hersh et al., 2015). To expedite HIE adoption by hospitals, the U.S. government provided about \$600 million to support development and implementation of HIE to enhance care coordination and reduce duplication of care (Adler-Milstein et al., 2016). Because of this funding, the adoption of HIE in U.S. hospitals increased from 41% in 2008 to 67% in 2013 (Rahurkar et al., 2015).

Several researchers have pointed out HIE's potential to improve healthcare service quality, which includes patient satisfaction as one of the key benefits (Ash & Guappone, 2007; Buntin et al., 2011). However, many hospitals using an HIE system tend to receive data from their network of healthcare providers, where a large volume of electronic health records (EHRs) needs to be aggregated for individual patients (Kuperman, 2011; Kierkegaard et al., 2014). The actual use and information quality of received patient records vary among hospitals depending on the implementation and adoption of HIE and other HITs such as EHRs and the hospital (i.e., organization); consequently, the effect of HIE on patient satisfaction may differ across hospitals (Coffetti et al., 2023).

Information technology managers often set the goal of improving organizational efficiency as the top information system success priority (Roh et al., 2005; Gorla et al., 2010). Information systems implementation and adoption are now considered essential to improve organizational efficiency (Frau, 2023). In hospitals, the EHR and HIE systems are two crucial health information systems (Jha et al., 2006). Therefore, successful implementation and adoption of EHR and HIE lead to an increase in organizational efficiency. Using the Hospital Compare dataset, prior studies demonstrated the impact of EHRs adoption on patient satisfaction (Kazley et al., 2012). However, research on how HIE adoption by hospitals contributes to patient satisfaction is still limited. Our study investigates the relationship between HIE adoption and patient satisfaction, therefore proposing a model that includes the role of organizational efficiency as a mediator of the relationship. Most of the prior HIE studies have examined intention to use and user perceptions of the value of HIE prior to use, while this study investigates the relationship between HIE adoption and patient satisfaction and addresses the call for continued HIE research to better understand the value of HIE (Feldman et al., 2022).

The findings of this study indicate that HIE adoption affects system success factors, such as organizational efficiency, which in turn affects patient satisfaction at the hospital level. Moreover, it provides a better understanding of the mediators between the HIE adoption and patient satisfaction, which is valuable in developing practices for improving patient satisfaction. Thus, healthcare managers should focus their efforts in areas known to be associated with the system success factors.

CONCEPTUAL FRAMEWORK

System Success Theory

This research builds on the conceptual foundation of the information system success theory. In their seminal work, Delone and McLean (2003) proposed the

system success theory of firms, a theory that describes the multidimensional and interdependent nature of system success. Subsequent research developed and tested system success measures at the firm level. Among these measures, organizational efficiency is a key indicator of system success, which is determined by the quality of information, organizational processes, and system support (Roh et al., 2005; Gorla et al., 2010).

In the corporate context, overall customer satisfaction is a fundamental indicator of success (Anderson et al., 1997). It is plausible that a firm can improve customer satisfaction by adopting a system to improve organizational processes via internal and external integration of the firm's business operations (Yu et al., 2013). Previous literature suggested that the increased organizational efficiency derived from system success has positive impacts on customer satisfaction (Nugraha et al., 2022). One of the main reasons is the standardization of organizational processes achieved due to the system results in higher efficiency, which contributes to the reliable production of desired services for customers (Anderson et al., 1997). Similarly, an HIE system that facilitates information integration and sharing in hospitals and among care providers can increase patient satisfaction. The success of HIE in improving organizational efficiency is a necessary condition to achieve the system's intended objective of patient satisfaction.

HIE Adoption and Organizational Efficiency

Researchers often use the terms efficiency and productivity interchangeably. According to Anderson et al. (1997), the most common type of organizational productivity measure is a ratio of output to a specific input, such as the number of employees. Menon et al. (2009) pointed out that hospital output is an important outcome in the healthcare industry and showed that hospitals became more efficient with increased output (inpatient days per employee) after the adoption of clinical information technology. There are a variety of ways to cumulate output from inpatient and outpatient departments. In this study, the number of patient discharges is used to measure hospital output, which is often used to measure hospital productivity (Carey & Stefos, 2011; Karmann & Roesel, 2017). To analyze hospital efficiency, we use total number of employees, hospital size in terms of number of beds, and ownership as control variables. Accordingly, the total number of patients discharged is used as the measure of organizational efficiency and the following hypothesis is proposed:

Hypothesis 1. HIE adoption positively influences hospital efficiency.

Researchers have suggested that significant relationships exist between the net benefits achieved and information system use at the organization level (Petter et al., 2008). Particularly, Belcher and Watson (1993) showed that the benefits (e.g., increased efficiency of employees) of adopting executive information systems encouraged continued use of these systems. In hospitals, the use of clinical data systems and HIE may enhance patients' satisfaction of the care they receive (Kazley et al., 2012; von Wedel et al., 2022). Accordingly, the following hypothesis is proposed:

Hypothesis 2. Hospital efficiency is positively associated with patient satisfaction.

Past research has found that an increase in computer use negatively affects clinician and patient interactions (Kumarapeli & de Lusignan, 2012). Evidence has suggested that electronic data use potentially undermines development of supportive, healing relationships with patients as physicians spend more time looking at the computer screen and interacting with the IT application being used (Rathert et al., 2017). However, healthcare facilities have become more dependent on HIT to improve organizational performance and healthcare outcomes. For example, effective sharing of patient information across healthcare facilities is essential for reducing costs and improving quality of coordinated patient care (Akhlaq et al., 2016) and about one third of the hospitals use HIE for sharing patients' information (Adler-Milstein et al., 2016). Several researchers, policy makers, and healthcare providers consider HIE important for providing quality and cost-effective coordinated patient care (Williams et al., 2012; von Wedel et al., 2022). The widespread use and importance of HIE makes it essential to study the effect of using HIE to share patient information on organizational performance and patient satisfaction. It is believed that use of HIE for sharing patient information will improve organizational performance because of greater care coordination across healthcare facilities (Brailer, 2005). The effectiveness of HIE in sharing patient information between healthcare facilities for coordinated patient care is expected to improve efficiency and patient satisfaction. Accordingly, the following hypothesis is proposed:

Hypothesis 3. HIE adoption in hospitals is associated with greater organizational efficiency, which in turn is associated with higher levels of patient satisfaction: whether the patient would recommend the hospital.

Based on the above hypotheses, Figure 1 shows the proposed research model.

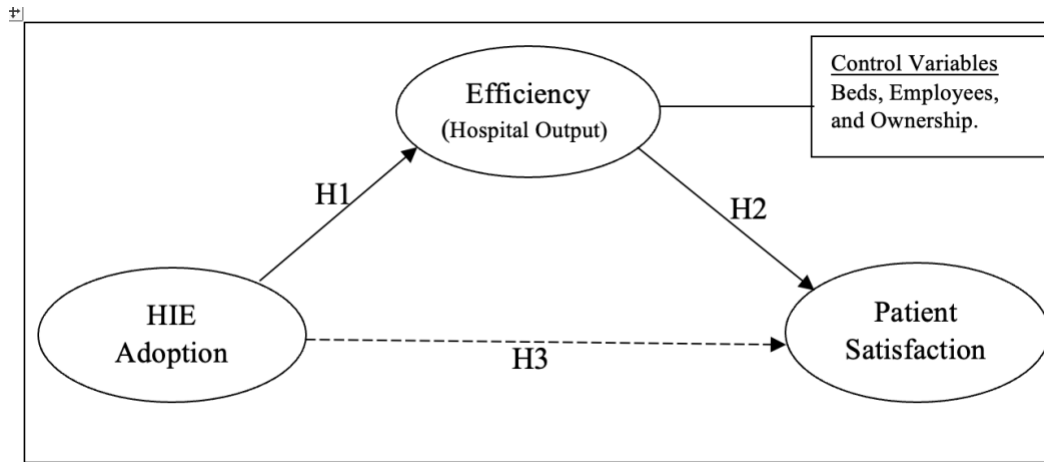


Figure 1. The Research Model

METHOD

We analyzed the dataset created for this research by integrating data from two U.S. administrative data sources: (a) data reported to Healthcare Cost Report Information System (HCRIS) and (b) Hospital Compare data downloaded from the Medicare.gov website. The dataset contained data from 2,459 Medicare-certified hospitals in the U.S. for the fiscal year 2013-2014.

Outcome Variable

Patient satisfaction (recommendation). Patient satisfaction was measured using patients' perceptions of their hospital experience about whether the patients would recommend the hospital to their friends and family. Using the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS), patients provide their responses by answering “never,” “sometimes,” “usually,” or “always” to the question about recommending the hospital to others. Hospital Compare has data regarding the percentage of patients who chose the most positive response option, “always,” for the question.

Explanatory Variable

HIE adoption. HIE adoption was represented by hospitals' ability to receive patient data and laboratory test (e.g., blood test) results from outside laboratories using a certified electronic health record system. Hospital Compare reports the hospitals' responses, which were recoded into binary data, with yes coded as "1" and the others coded as "0."

Mediating Variable

Efficiency. Efficiency was measured by hospitals' total patient discharges. The HCRIS data set includes the total number of discharges reported by hospitals.

Control Variables

We included the following control variables: the number of beds, the number of employees, and the type of ownership. The HCRIS data set provides these data. The types of ownership used in our analysis were non-profit, government, and private, which were subsequently coded as 1, 2, and 3, respectively.

RESULTS

Table 1 provides the mean, standard deviation, and median for all variables used in the analyses. Table 2 presents the Pearson correlations among the main variables. Most of the values of correlations are small, falling within the range of ± 0.3 . However, several variables are significantly correlated with one another. The largest correlation is 0.853 between employees and efficiency, followed by 0.656 between beds and efficiency and 0.603 between employees and beds. To examine the possibility of multicollinearity, the Variance Inflation Factor (VIF) was calculated and found to be less than the critical value of 10 (Benitez-Amado & Walczuch, 2012; Gujarati, 2003; Petter et al., 2007). This provides evidence that there are no multicollinearity problems in the estimation.

Table 1. Descriptive Statistics

Variables	N	Mean	Standard Deviation	Median
Recommendation	2459	70.57	9.67	71
HIE adoption	2459	0.87	0.34	1
Efficiency	2459	9324.62	10726.57	5933
Beds	2459	200.34	276.30	139
Employees	2459	1256.17	1700.30	727.97
Ownership	2459	1.53	0.85	1

Table 2. Pearson Correlation

Variables	Recommendation	HIE Adoption	Efficiency	Beds	Employees	Ownership
Recommendation	1.000					
HIE adoption	0.001	1.000				
Efficiency	0.128***	0.157***	1.000			
Beds	0.048*	0.121***	0.656***	1.000		
Employees	0.143***	0.147***	0.853***	0.603***	1.000	
Ownership	-0.145***	-0.039	-0.125***	-0.046*	-0.168***	1.000

Notes.

*** - Correlation is significant at the 0.001 level (2-tailed).

** - Correlation is significant at the 0.01 level (2-tailed).

* - Correlation is significant at the 0.05 level (2-tailed).

a. - Listwise N = 2459.

Table 3 provides the empirical results according to the measure of patient satisfaction: recommendation. According to these results, there is a positive relationship between HIE adoption and organizational efficiency with a coefficient of 0.081 (p-value < 0.001), which indicates that hospitals adopting HIE have better efficiency. The results provide strong support for Hypothesis 1. Consistent with the Hypothesis 2, we find a positive association between hospital efficiency and recommendation with a coefficient of 0.059 (p-value < 0.05). This suggests that hospitals with greater efficiency are more likely to have better patient satisfaction in terms of recommendation, which means the patients are more likely to recommend these hospitals. In addition, as explained below, findings of this research suggest that organizational efficiency mediates the relationship between HIE adoption and patient satisfaction in terms of recommendation. Therefore, Hypothesis 3 is supported.

Table 3. Empirical Results

	Predicted Sign	Efficiency	Patient Satisfaction: Recommendation
			Coefficient (Standard Error)
Intercept		0.110 (0.046)	7.237 (0.082)
HIE Adoption	+	0.081 (0.025) ***	
Efficiency	+		0.059 (0.028) *
Beds	+	0.086 (0.070)	-0.022 (0.015)
Employees	+	0.452 (0.080) ***	0.061 (0.014) ***
Ownership	-	0.008 (0.015)	-0.139 (0.026) ***
R ²		0.76	0.04
N		2459	2459

Notes.

*** - Correlation is significant at the 0.001 level (2-tailed).

** - Correlation is significant at the 0.01 level (2-tailed).

* - Correlation is significant at the 0.05 level (2-tailed).

a. - Listwise N = 2459.

The three-step analysis suggested by Zhao et al. (2010) was used to test the mediation effect of organizational efficiency in the relationship between HIE adoption and patient satisfaction. The three-step analysis process included the following: (a) we first estimated and tested the path between the mediator, organizational efficiency, and the independent variable, HIE adoption (i.e., path a); (b) then, we tested the path between the dependent variable, patient satisfaction (recommendation), and the independent variable, HIE adoption (i.e., path b); (c) we regressed the dependent variable on both the independent variable and the mediator (i.e., path c). The indirect effect analysis was performed by means of the Sobel-Goodman mediation test (Saade & Kira, 2009). The result of these analyses concludes that the indirect effect (path a*b) is significant with $p < 0.05$ and the direct effect (path c) is insignificant. According to the recommendation by Zhao et al. (2010), this is an indirect-only mediation, which indicates that the mediator variable, organizational efficiency, fully mediates the relationship between HIE adoption and patient satisfaction in terms of recommendation (Baron & Kenny, 1986; Zhao et al., 2010). This provides evidence that HIE adoption may help hospitals with better efficiency which indirectly affects patient satisfaction, leading to patients recommending the hospital.

With respect to control variables, we find that the number of beds is not associated with patient satisfaction. We also find that the number of employees is positively associated with patient satisfaction in terms of recommendation. This indicates that the hospitals with more employees are more likely to have resources to pay specific and expeditious attention to each patient, which results in better patient satisfaction. Satisfied patients are more likely to recommend a hospital to others. In addition, the findings provide evidence that ownership is negatively related to patient satisfaction in terms of recommendation, which suggests that the non-profit hospitals are more likely to satisfy the patients.

DISCUSSION

There has been a significant increase in the use of HIT in the healthcare industry since 2007 (Bui et al., 2018; Wu et al., 2023). However, there is still lack of clear evidence of positive relationships between HIT use and key measures of healthcare outcomes, such as quality of patient care, patient mortality, and satisfaction (Bui et al., 2018; Harrison et al., 2007). The system success theory has shown a significant relationship between the constructs, uses, and net benefits of using information systems, such as HIE, measured in terms of organizational performance and effect on work practices (Petter & McLean, 2009). In this paper, we used system success theory to examine the relationship among HIE adoption, hospital efficiency, and patient satisfaction. Specifically, this study contributes to the literature by extending

the prior research by investigating the mediating role of hospital efficiency. Our results indicate that HIE adoption positively impacts hospital efficiency. In addition, hospital efficiency positively influences patient satisfaction. Furthermore, the findings validate the mediation role of hospital efficiency and suggest that HIE adoption indirectly affects patient satisfaction through hospital efficiency.

We need to acknowledge a few limitations of this study. It primarily focuses on patient satisfaction due to the availability of the data. Future study could consider investigating the effect of HIE adoption on clinical outcomes and quality of patient care. While this research provides valuable insights into the effects of HIE adoption, the results indicate a significant increase in efficiency as a result of adopting HIE. However, it is essential to recognize that this increase in efficiency has only limited impact on patient satisfaction, as indicated by a low R^2 value in the analysis. This limitation may stem from the study's emphasis on efficiency enhancements rather than a comprehensive evaluation of the various factors influencing patient satisfaction. Future research could explore these additional factors. Another limitation is that this study is based on previous years' data due to the availability and feasibility of the data collection process. Future research may benefit from collecting more data to extend the analysis and validate the results. Finally, the data used for this study is for hospitals in the U.S.; therefore, the results may not be generalized globally and to other types of healthcare organizations such as long-term care facilities.

PRACTICE IMPLICATIONS

This study provides practical implications for healthcare providers and hospitals regarding the value proposition of adopting HIE and its positive impact on efficiency. It suggests that healthcare providers should increase investment in information technology adoption based on our findings. More importantly, our results show that hospital efficiency plays a mediating role between HIE adoption and patient satisfaction. This finding implies that system implementation and management is crucial for the HIE adoption and success in hospitals to improve healthcare outcomes. It is essential for healthcare managers to recognize that HIE systems' implementation and adoption relies on a collaborative approach involving various stakeholders, such as external healthcare providers and organizations and policymakers. Policymakers can promote HIE adoption by incentivizing healthcare organizations to adopt HIE technologies and establishing national standards for HIE interoperability. This can help ensure that HIE is widely adopted and integrated into the healthcare system, leading to improved patient satisfaction and health outcomes. However, due to the complexity of such an approach, investment in HIE adoption in hospitals may take longer than expected to yield organizational efficiency

(Appari et al., 2013). Hospitals that overcome implementation and adoption challenges are likely to achieve greater patient satisfaction due to greater patient information sharing, improved care coordination across healthcare facilities, better diagnoses, and more effective treatment plans (Walker, 2018).

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