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Amit Malhan
North Carolina Agricultural and Technical State University

Robert Pavur
University of North Texas

Lou Pelton
University of North Texas

Ila Manuj
University of North Texas

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Role of Electronic Healthcare Record Adoption in Enhancing the Relationship between Quality Measures and Hospital Financial Performance

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Amit Malhan[a], Robert Pavur[b], Lou Pelton[c] and Ila Manuj[d]

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ABSTRACT

Electronic Health Records (EHRs) are designed as a real-time digital record to streamline distinctive and valuable patient information across multiple stakeholders in the healthcare delivery channel. The stakeholders include hospitals, healthcare providers and patients, as well as a myriad of third-party providers (i.e., insurance companies, Medicare). Academicians, practitioners and public policy makers are grappling with uneven experiences and empirical findings regarding the relationship between technology-enabled information sharing and the ensuing quality of healthcare outcomes. The most significant government-mandated technology is the implementation and adoption of EHR. The present research examines EHR through the lens of Resource Advantage Theory –– to empirically assess how partial and comprehensive implementation levels of EHR adoption influence quality management and financial performance of hospitals. Based on archival data attained from 210 hospitals in the state of Texas, the results indicate positive relationships between EHR and the quality of care. While it is generally recognized that EHR and quality management affect a hospital's performance, this research investigates the moderating effect that EHR has on quality management and a hospital's performance. These findings provide hospital administrators, practitioners, and third-party payers with an integrative and parsimonious model to understand the impact of partial and comprehensive levels of EHR implementation on the relationship of healthcare quality and hospital performance.

KEYWORDS

Medical Information Technology, Health Information Management, Quality Management, Hospitals

INTRODUCTION

In one of the most notable reports by Institute of Medicine (IOM) at the end of the 20th century, the IOM issued a national call for a collective effort to make healthcare delivery safer in the U.S. as well as to promote healthcare competencies (Greiner & Knebel, 2003). Although the report has been widely credited with spawning efforts to study and improve safety and competencies in health care, there has been limited objective assessment of its impact. The report did not seek to identify channel members who specifically compromised healthcare performance outcomes; instead, it focused on the role of process and systems management in ameliorating healthcare delivery. The overarching finding of the report was a need for integrative, reliable and robust information transfer enabled by technology. This report reinforced the growing attention to findings from the logistics and operations management literature suggesting that the implementation of information technology (IT) can improve service quality across sectors (Haywood-Farmer, 1988). Researchers remark that the dramatic

[a] North Carolina Agricultural and Technical State University, North Carolina, U.S. (asmalhan@ncat.edu)
[b] University of North Texas, Texas, U.S. (pavur@unt.edu)
[c] University of North Texas, Texas, U.S. (LouE.Pelton@unt.edu)
[d] University of North Texas, Texas, U.S. (Ila.Manuj@unt.edu)

Corresponding Author:
Malhan (asmalhan@ncat.edu)

increase in information technology investments has not been accompanied by the expected increase in productivity, but researchers suggest that it might do so in future (Das et al., 2011).

Electronic Health Record (EHR) implementation is expensive and impacts financial performance, but research suggests that total margins typically improve after two years (Collum et al., 2016). Parallels exists between enhanced organizational performance leveraged by IT and enhanced hospital performance using EHR as a managerial tool in the complex, information intense and heterogeneous healthcare industry. These parallels include increased quality and user satisfaction, efficiency of service, increased information awareness, and improved engagement by the user. Although both IT and EHR enhanced services provide all four of these healthcare benefits, EHR enhancement makes information awareness and engagement more personalized with greater ease of use. Healthcare organizations are moving toward connecting more medical devices with the Internet of Medical Things (IoMT) using blockchain technology to enhance trust (Meng et al., 2019). EHRs allow for efficient use of IoMT and are essentially, a game changer. Frameworks using data-driven analytics, such as engineering project health management, have been proposed to provide a complementary set of managerial tools rooted in analytical methodology (Snider et al., 2019). Input data for these managerial decision-making tools could come from EHRs.

An EHR is defined as "a digital version of a patient's paper chart. EHRs are real-time, patient-centered records that make information available instantly and securely to authorized users. While an EHR does contain the medical and treatment histories of patients, an EHR system is built to go beyond standard clinical data collected in a provider's office and can be inclusive of a broader view of a patient's care" (www.HealthIT.gov). The extant findings associated between EHR and quality of healthcare lack generalizability due to the small scale of studies and a general lack of an integrative approach. Most of the studies lack a theory-driven approach and are based on descriptive indicators (Chaudhry et al., 2006). According to a systematic review of 287 articles, there has been sufficient evidence to posit that health information technology does improve efficiency, effectiveness, and cost of care (Chaudhry et al., 2006). But this review was done before the two most historic legislative initiatives in American history: the passage of the Affordable Care Act (ACA) and The Health Information Technology for Economic and Clinical Health Act. All research before these legislations obviously disregards the impact of the consequential regulatory and systemic changes in today's healthcare delivery channel. While ACA was aimed at improving the quality of care, reducing costs and increasing accessibility of care, initial reports from the Office of Management and Budget suggest that the implementation of the ACA may have led to unexpected detrimental outcomes.

Although multiple medical studies have examined how EHR impacts specific clinical quality measurements, this is the first comprehensive empirical study to examine both aspects of quality of care and financial performance as influenced by partial and full implementation of EHR. Studies of the healthcare industry that model perceptions of health care quality practices are long-standing and include quality improvement research in the healthcare industry (Prybutok et al., 1999). Many healthcare-related studies sample individual health users using empirical data from online healthcare communities to understand health information-seeking behavior of users (Liu et al., 2017). In contrast, our study uses healthcare datasets, as available from the American Hospital Directory and the American Hospital Association, and uses this data to model financial performance. Therefore, this research addresses a call for providing an integrative and comprehensive view in healthcare instead of extant fragmented approaches (Cebul et al., 2008).

This study is motivated by two research objectives. The first research objective is to establish support for the role of full implementation of EHR's in achieving improved hospital financial performance. The second objective is to establish support for EHR as a moderator of the relationship of quality of care and financial performance. To address these objectives, we conducted a cross-sectional study of 210 hospitals to model the relationship between quality management measures and

hospital operating margin and with EHR moderating the relationship. Since previous research in operations management supports the improvement of performance from technology investment (Hendricks et al., 2007), we investigate the full and partial implementation of EHR in achieving improved hospital financial performance. The findings of our research provide both practical and theoretical implications for the multiple stakeholders impacted by EHR adoption. Consistent with the extant quality management literature, we proffer implications for both organizational (e.g., hospital) and individual (e.g., healthcare provider) performance outcomes in the conclusions section.

THEORETICAL FOUNDATION

We grounded our hypotheses in the resource advantage theory of competition that asserts that "Sustained, superior financial performance occurs when a firm's comparative advantage in resources continues to yield a position of competitive advantage despite the competitive actions of rivals" (Hunt & Morgan, 1997). Consistent with the relevance of resource advantage theory in the healthcare industry context, we argue that EHR plays a role as a moderator on the relationship of quality and financial outcomes. Total quality management (TQM) in healthcare is a major long-term strategic initiative of hospital management supported by quality metrics. We propose that investment in EHR improves a hospital's financial performance because of its role in improving TQM. Its role is consistent with the literature on quality management and financial performance (Harrington, 1987; Crosby, 1979; Feigenbaum, 1956) although there is a lag in realizing operational efficiency.

Resource advantage theory is suited to the study of healthcare for four reasons. First, the theory reinforces the importance of macro-environmental factors (political, economics, and public policy forces). The value of a resource is viewed by its potential to yield competitive differentiation. Therefore, it is ideally suited to studying healthcare where these factors have a significant influence.

Second, resource advantage theory argues that it is not the resource by itself but its interaction with other resources that yields a competitive advantage. "Resources are defined as the tangible and intangible entities available to the organization that enable it to produce efficiently and effectively a market offering that has value for some market segment" (Hunt & Davis, 2008, pp. 13). Resource advantage theory identifies seven different resources: physical, financial, organizational, informational, legal, human and relational (Hunt & Morgan, 1997). In the context of the healthcare sector, EHR is an informational resource that can result in competitive advantage through optimization of existing hospital resources, including relational (patient satisfaction), physical (beds), capital (hospital size, beds, and equipment) and human (nurses, doctors, and IT staff) resources that translate into organizational competencies (superior quality management). Studies show that TQM and its constituent factors such as open culture, socio-technical integration, strategic interventions, sustainability, empowerment, bench marking, and process improvement can improve firm performance (Chaudhuri, 2019). Ample literature shows that improved firm performance is linked to superior financial performance (Jacobs et al., 2016).

Third, the theory considers relationships as an important resource. In healthcare, the patient-provider relationship is critical to delivering effective care (Brennan et al., 2013). Fourth, the fundamental premise of the theory suggests that user information is imperfect and when used strategically can become a resource for competitive advantage. EHR can streamline and optimize vital patient information which can be used to deliver cost-efficient and effective care.

TOTAL QUALITY MANAGEMENT

The most important metric in the healthcare sector is the quality of care. The Institute of Medicine defines health care quality as "the degree to which health care services for individuals and populations

increase the likelihood of desired health outcomes and are consistent with current professional knowledge." Based on quality types in the management field (Reeves et al., 1994), we have divided healthcare quality into three constructs: User-Based Quality, Value-Based Quality, and Benchmark Quality.

USER-BASED QUALITY AND FINANCIAL PERFORMANCE

Hospitals are multi-product firms with multiple sources of revenues. Improving operating margins provides hospitals with more options to invest in new or improve existing services. Hospitals provide inpatient and outpatient health care services, and they may provide other services to those using the hospital as well as to ancillary healthcare providers. Some of the support services not directly related to healthcare service, but managed by the hospital's administration, include cafeteria services and catering, laundry and parking. Some hospitals are involved in medical or related education; some are primarily research facilities. Hospitals may receive philanthropic gifts, government subsidies, or interest and investment income that may not be directly tied to any operational activities.

According to Agency for Healthcare Research and Quality (AHRQ), the first dimension of financial health is that revenues and expenses are in balance. At the least, we should expect that revenues match expenses, i.e., break even. Most stakeholders expect an institution's revenues to exceed expenses and a hospital's budget to finance increases in working capital and build funds as a cushion for a financial downturn, renovation, or expansion. A widely accepted measure of profitability is the operating margin. Accordingly, in this study, the selected measure of financial performance is the hospitals' operating margins.

In operations, user-based definitions of quality build upon the idea that quality is the degree to which a product or service satisfies the user's needs, wants, or preferences (Gronroos, 1982; Parasuraman et al., 1985). In healthcare, user-based quality can be related to service approaches. Activities and processes that help reduce the cost to the patient unnecessary pain, and delays, as well as enabling accurate information dissemination are related to patient satisfaction and can be improved through investment in business processes (Chaudhry et al., 2006; Brennan et al., 2013). Researchers investigated the association of hospital quality measures and a hospital's return on investment (ROA) and found that operating margins improved significantly after two years of EHR adoption in hospitals as well as an association of EHR with improved quality of care (Wang et al., 2018). Therefore, we propose a similar hypothesis using operating margin.

H1: User-based quality is positively associated with operating margin.

BENCHMARK QUALITY AND FINANCIAL PERFORMANCE

Benchmarking enables hospitals to identify their weaknesses and assess their practices. In particular, benchmarking allows for process improvement, which lowers costs and ensures that strategic goals are being followed. Benchmarking has been essential in the manufacturing business sector to achieve "conformance to requirements/specifications" and thereby to improve an organization's competitive advantage (Gilmore, 1974). In healthcare, AHRQ sets the quality standard for patient care. AHRQ publishes a set of indicators that are quantifiable and measurable (e.g., mortality rates, readmissions, complications) that may be used in benchmarking strategies. Numerous studies have supported a positive relationship between benchmarking practices and the financial health of an organization (Wolfstadt et al., 2008; Powers et al., 2018; Bates et al., 1997; Bates et al., 1998; Moja et al., 2019). Technological tools are emerging to make internal and external benchmarking practices more relevant to an organization's profitability (Overhage et al., 1996; Overhage et al., 1997; Tierney et al., 1990; Teich

et al., 2000; Chertow et al., 2001). Given the preponderance of evidence for benchmarking practices to strengthen an organization's financial position, we hypothesize that:

H2: Benchmark quality is positively associated with operating margin.

VALUE-BASED QUALITY AND FINANCIAL PERFORMANCE

The value-based approach assesses quality in terms of costs and benefits; the more that benefits outweigh costs, the more a product or service increases in value (Feigenbaum, 1956; Abbott, 1973). In terms of healthcare, value-based quality represents healthcare delivered in an efficient manner but with lower cost to the patient. The up-front capital costs of improving healthcare quality often obscures the potential long-term benefits to both the clinician and the patient (Tierney et al., 1987). Benefits of such investments increase efficiency in hospitals. Examples of benefits include efficiency in assessing a patient's progress whether it be preventive care or critical care and decreases in events such as a patient's likelihood of readmission and miscalculation of nurse-census ratios for admitted patients. Cost inefficiency may occur in different ways: technical, allocative, scale, or scope (Rosko et al., 2020). Inefficiencies occur when hospitals fail to use the least costly combinations of resource inputs in generating optimal service requirements. Rosko et al. (2020) state that "the pursuit of efficiency has become a central objective of policy makers within the healthcare systems." Prior research supports that hospitals with low operating margins usually will not make substantial investments in efficiencies needed to improve value-based quality. Therefore, we hypothesize that:

H3: Value-based quality is positively associated with operating margin.

EHR AS A MODERATOR OF QUALITY MANAGEMENT AND FINANCIAL PERFORMANCE

As noted earlier, patient satisfaction is a key hospital performance metric that has become increasingly important to the medical community due to its relationship to practice guidelines, clinical quality, and mortality (Glickman et al., 2010). Patient satisfaction is often negatively associated with operating margin since productivity has a lagged effect. To understand this relationship, one must recognize that patient satisfaction correlates with financially stable practices since patients are increasingly expecting quality service just as they would in other consumer services. Patient satisfaction has a positive relationship with improved customer loyalty, hospital reputation, and increased referrals as well as lower risks for malpractice claims and this relationship translates into improved financial performance (Blackman, 2021). Hospitals are required to submit measures of patient satisfaction as a result of the Tax Relief and Health Care Act of 2006. The Center of Medicare and Medicaid Services (CMS) Care Compare website (https://www.medicare.gov/care-compare/) allows for consumers to compare quality measures and encourages benchmark comparisons.

Our study uses the measures of hospital patient quality as published by CMS. Low-patient-satisfaction measures impact a hospital's reputation and limit a hospital's ability to build a robust consumer base. The costs of quality identified in the aspiration triadic principle of "prevention–appraisal–failure" can be related to patient satisfaction. There is a saying "we cannot improve what we cannot measure." Thus, benchmark quality plays a vital role in the operating margin of hospitals. Failures, such as adverse drug events are estimated to cost the U.S. hospital system between $1.56 and $5.6 billion annually due to readmission and hospitalization costs as well as malpractice and litigation fees (Bates et al., 1997). Therefore, poor quality increases the operating expense of hospitals and reduces the operating margins.

Value-based quality consists of several components: standardized practice, clinical decision support, efficient interdepartmental communication, data management, research, and quality monitoring (Chaudhry et al., 2006). Adherence to this process forms routines that have been defined as "regular and predictable patterns of activities which are made up of a sequence of coordinated actions by individuals" (Grant, 1991). Researchers have long recognized the value that routines provide to organizations for improving operations (Grant, 1991; Peng et al., 2008; Nelson et al., 2018). Therefore, value-based operational quality improves business and service processes and thereby is positively associated with operating margin. An example of value-based quality that contributes to operating excellence is investment in training a medical staff to adhere to computerized EHR alerts and reminders to optimize managed care. Prior research reveals that administrators can minimize excessive costs by using value-based capabilities, such as EHR reports, to verify whether the patient was informed by the clinician that she was eligible to receive services such as specialized diagnostic procedures, mental health coverage, health screenings, and wellness counseling, in addition to motivating clinicians to follow hospital guidelines (Overhage et al., 1996; Overhage et al., 1997; Dexter et al., 2001).

Research on the benefits of EHR suggest disparities in the rate of EHR adoptions and in the level of EHR implementation. In this study, EHR is categorized as partial or full to determine EHR's effect on operating margin as a moderator. Since less than 3% of the hospitals in Texas from our CMS database have no EHR implementation, these few hospitals were merged with the partial implementation group of hospitals. The partial implementation category in our study includes both partial (basic) EHR implementation and no EHR. The comprehensive category includes hospitals that have replaced paper or computerized records of health documentation with documentation within an EHR framework system to benefit from EHR's functionalities. For a hospital to be considered in the full implementation of EHR category, hospitals must adopt a comprehensive EHR system throughout their hospital. More than 50% of the Texas hospitals have fully implemented EHR. The full economic benefits of EHR may be realized only through a comprehensive implementation. Full implementation of EHR should be transformative and part of a hospital's strategic approach to improving total quality care. We hypothesize that:

H4: Full implementation of EHR enhances the relationship between user-based quality and a hospital's operating margins.
H5: Full implementation of EHR enhances the relationship between benchmark quality and a hospital's operating margins.
H6: Full implementation of EHR enhances the relationship between value-based quality and a hospital's operating margins.

RESEARCH METHODOLOGY

We merged data from 610 hospitals in Texas using three separate data sources: American Hospital Directory (AHD), American Hospital Association (AHA) and the CMS database. The AHD provided general demographics data, CMS provided quality indicators, and AHA provided EHR data. From these 610 hospitals, we selected hospitals that participated in a value-based purchasing (VPB) program set by the CMS because such hospitals are motivated to increase their total performance scores tracked by CMS. The VBP program rewards a participating hospital with incentive payments based on its quality of care rather the quantity of services provided. The rationale for this data sifting is to have a standardized unit of measurement across all the hospitals that are being studied. This selection process resulted in a sample size of 210 hospitals. EHR implementation is measured on a three-point scale as developed by the AHA. AHA collects survey data annually from U.S. hospitals, makes the data

available using its AHA Data Viewer, and assigns EHR scores based on responses regarding the extent of EHR implementation (see Appendix).

EHR adoption is classified into the following two categories: No/Basic EHR and Comprehensive EHR adoption. A "comprehensive" EHR is defined as the adoption of EHR across all major clinical units in the hospital, and a "basic" refers to adoption of EHR in some units of the hospital. No adoption refers to complete absence of EHR in any unit of the hospital. However, very few hospitals have no adoption. EHR was implemented in this study as being either partial, which includes no/basic EHR, or as being comprehensive. The comprehensive category includes hospitals that have a complete fully implemented EHR system.

To measure patient satisfaction, we used results from the Hospital Consumer Assessments of Healthcare Providers and Systems (HCAHPS) survey for the year 2014 as the HCAHPS surveys are considered the standard for capturing patient assessments of care (O'Malley et al., 2005). In this study, we are using the HCAPHS indicators. These data are published by CMS and are quantifiable measures of patient satisfaction that includes pain management, the responsiveness of medical staff, post-discharge communication and cleanliness of the hospital. The HCAHPS survey asks recently discharged patients to rate several the following categories, on a scale of 1 to 10: communication with doctors, communication with nurses, the responsiveness of hospital staff, pain management, and discharge information, communication about medicines and cleanliness and quietness of the hospital environment. We used a 10-point final score to measure patient satisfaction. Higher scores are positively associated with greater patient satisfaction, and lower scores indicate patient dissatisfaction. To measure benchmark quality, we used indicators developed by American Healthcare Research and Quality and CMS, agencies within the U.S. Department of Health and Human Services. Benchmark quality is built on the following dimensions: patient safety indicators, hospital-acquired complication and death, and re-admission. We recoded this benchmark quality score as being between 0 and 10 so that it would be on the same scale as the patient satisfaction with higher values referring to higher quality levels.

To measure value-based quality, we used part of the total performance score that CMS uses for reimbursement to hospitals for the fiscal year 2014. CMS publishes a value-based indicator called Medicare Spending Per Beneficiary (MSPB) to measure this construct. The MSPB measure evaluates a hospital's efficiency, as reflected by Medicare payments made during an MSPB episode, relative to the efficiency of the median hospital. An MSPB episode includes all Medicare Part A, and Part B claims paid during the period from 3 days before hospital admission (i.e., index admission) through 30 days after discharge from the hospital (https://www.medicare.gov/hospitalcompare/Data/spending-per-hospital-patient.html). Variation in payments due to geographic and health risk status are controlled for in this study. Lower MSPB scores indicate greater efficiency. However, we recoded this value-based score as being between 0 and 10 so that it would be on the same scale as the patient satisfaction and benchmark quality with higher values referring to higher quality levels.

To collect data on operating margins, we used data from the Healthcare Cost Report Information System (HCRIS) for the fiscal year 2015. CMS has made a reasonable effort to ensure that the provided data/records/reports are up-to-date, accurate, complete, and comprehensive at the time of disclosure. This information reflects data as reported to the HCRIS.

Our study recognizes the temporal interplay between predictor variables such as technological implementation, employee training, and customer satisfaction, on economic variables such as operating profit. To achieve sustained success, a deeper understanding of the functioning of the EHR with respect to time lags and feedback loops needs to be recognized. To model financial performance, it must be understood that EHR will have a lagged effect on performance as most technological effects are recognized only in the long run. Likewise, quality management and implementation of training is expected to have a lagged effect on performance. The literature supports the use of lagged effects in

modeling economic performance as large investments and changes in operational efficiency are expected to pay off over an extended span of time (Evanschitzky et al., 2012). The reason for using different years for each construct was because EHR is a technological resource and effects of any technological implementation are realized after a few years of its implementation (Bouwman et al., 2005). Same year data for EHR, quality metrics, and operating margin will not illustrate the true benefits of EHR implementation. Therefore, the variable EHR implementation was recorded for the year 2013. Insights gained from models that include lagged operational variables provide valuable managerial guidance for effective decision making to improve the performance of the EHR over the long run. The quality metrics data were from 2014 and operating margin data was from 2015.

DATA ANALYSIS

Figure 1 displays the conceptual model for this study and presents the relationship of the constructs of user-based quality, value-based quality, and benchmark quality with operating margin as being mediated by the implementation of EHR. The hypotheses need to be interpreted in terms of the full model with interaction terms (Hayes, 2013). A general linear model (GLM) was fitted to 210 observations in SAS. The overall model was significant with a p-value < .001 and an F statistic of 8.72. The R-square was 23%. The predictor EHR Partial Implementation was coded as 1 for partial implementation (none/basic) and 0 for a comprehensive implementation. Table 1 provides the descriptive statistics for the predictor variables and operating margin as well as a table of correlations.

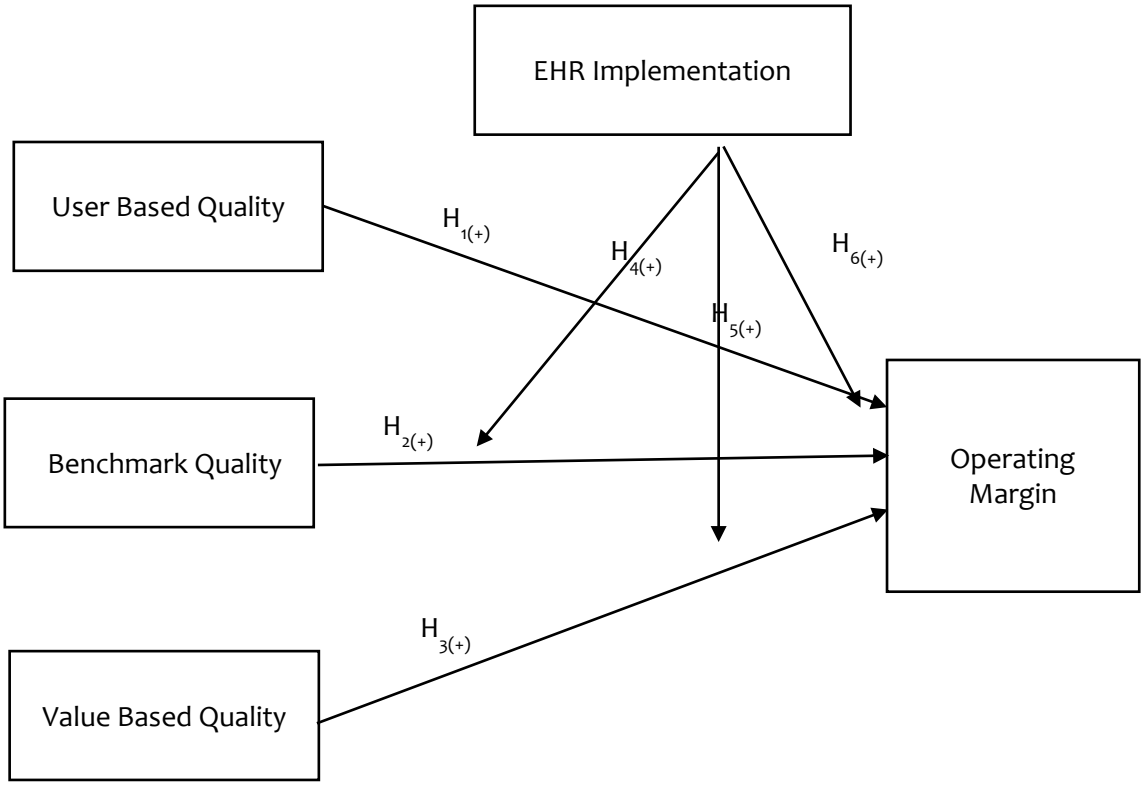

Figure 1. Moderation Model of EHR Implementation on Relationship of Quality Management Measures with Hospital's Operating Margin

Table 1. Means, Standard Deviations, and Correlations of Predictor Variables and Dependent Variable Operating Margin for 210 hospitals.

	Mean	Standard Deviation	EHR Partial Implementation	Benchmark Quality	User Based Quality	Value Based Quality
EHR Partial Implementation	*0.595*	*0.492*	*1.000*			
Benchmark Quality	*5.242*	*1.674*	*-0.139**	*1.000*		
User Based Quality	*2.943*	*3.130*	*0.028*	*0.135**	*1.000*	
Value Based Quality	*7.729*	*0.933*	*-0.145**	*-0.021*	*0.095*	*1.000*
Operating Margin	*-2.286*	*35.125*	*-0.064*	*0.341****	*0.222***	*-0.151**

Notes: * Significant at the p < .05 level; ** Significant at the p < .01 level; *** Significant at the p < .001 level

Table 2. Results of Model Predicting Operating Margin with Quality Measures as Moderated by EHR Partial implementation

Predictor Variable	Regression Coefficient	Test Statistic	P-value	Hypothesis Test
EHR Partial Implementation	*-12.065*	*-0.29*	*0.7691*	
User Based Quality	*2.696*	*2.95*	*0.0035*	*H1: Supported*
Benchmark Quality	*8.813*	*5.64*	*0.0001*	*H2: Supported assuming full implementation of EHR*
Value Based Quality	*-10.089*	*-3.25*	*0.0014*	*H3: Not Supported; Significant in Opposite Direction*
User Based Quality * EHR Partial Implementation	*-0.980*	*-0.680*	*0.4957*	*H4: Not Supported*
Benchmark Quality * EHR Partial Implementation	*-9.195*	*-3.13*	*0.0020*	*H5: Supported*
Value Based Quality * EHR Partial Implementation	*8.778*	*1.83*	*0.069*	*H6: Not Supported at 5% level.*

Table 2 reveals that EHR implementation moderates benchmark quality at the 1% significance level and moderates value-based quality at the 10% significance level. Both user-based quality and benchmark quality have significant positive associations with operating margin. Since benchmark quality is moderated by EHR implementation, Figure 3 provides insight into the type of moderation. Figure 3 clearly reveals that with partial implementation of EHR benchmark quality does not have a relationship with operating margin as indicated by the mostly horizontal line. However, when full implementation of EHR is present, the trend is significantly positive as hypothesized. The last column

of Table 2 displays the conclusions to the proposed hypothesized claims. Although implementation of EHR, as a predictor by itself, is not significant in Table 2, this predictor is important in the moderation of the quality measure with operating margin.

Figure 2 reveals the relationship of user quality with operating margin. Clearly the predicted operating margin lines for partial implementation and full implementation are parallel and this is supported by an insignificant interaction. However, when full implementation is present the operating margin is higher in Figure 2, which is encouraging. Perhaps, the most interesting result from this study is Figure 4. The proposed hypothesis related to Figure 4 states that the relation between value-based quality and operating margin should be positive. However, when there is partial implementation of EHR the relationship is flat. This flat trend implies that when implementation of EHR is partial, that increases in value-based quality do nothing to increase the operating margin. Figure 4 reveals that full implementation of EHR decreases the operating margin as value-based quality increases. An interpretation of this trend is that the price of EHR with increased value-based quality becomes costlier. The shift to a value-based system may provide returns very slowly. The health care facility may be slow at utilizing the value-based landscape. However, the operating margin is higher for the full implementation of EHR then for the partial implementation of EHR, which motivates persistence in fully implementing EHR.

FINDINGS

The most insightful results of this study are Figures 2, 3, and 4. Figure 2 displays the relationship between user quality and operating margin. User-based quality, indeed, plays an important role in a hospital performance. Previous studies have recognized that patient satisfaction is vital to a hospital's financial health. In this figure, it appears that EHR implementation increases the operating margin, but does not depend on the level of user quality (Chaudhry et al., 2006). Perhaps, the patient does not interpret having an electronic record as being as important as the service and quality of care. Medical personnel explaining to patients their medical record from a computer screen or electronic record may not be perceived by the patient as enhancing the relationship with the medical staff. The relationship of user-based quality and the adoption of EHR may still be evolving. Consistent with the extant marketing literature, enhanced customer experience should result in positive mouth word-of-mouth and patronage behaviors and thus higher revenue.

Figure 3 is striking in that full implementation of EHR appears to be beneficial to the hospital's operating margin only if the benchmark quality is above a certain level. If benchmark quality is low, then implementation of EHR is too costly for a system that is not efficient. High benchmark quality provides the right environment for EHR implementation to result in improved workflow and efficiency to reduce cost. After full adoption of a new technology, superior quality management is reflected in efficient and reliable delivery processes, cost reductions and controls, increased patient satisfaction, and exceptional conformance quality (Boyer & Lewis, 2002; Swink & Hegarty, 1998; Jayaram & Xu 2016). These performance enhancements can lead to competitive advantage and the corresponding financial rewards.

Figure 4 reveals that EHR implementation is a significant moderator, but in the opposite direction hypothesized. Increasing value-based quality without EHR implementation does not translate into higher operating margins. Full EHR implementation is still important. EHR is a technological resource, and technological resources require heavy upfront capital investment. Benefits are realized over the long term. Hence, the hospital which implemented a comprehensive EHR, may or may not be able to deliver the care at an affordable cost in initial stages after implementation. As with any new technology, there is an initial learning curve and training, which requires time, effort and capital investment. The information technology research to date supports the temporal variance from the

outset of technology adoption through later stages of implementation. Perhaps, higher quality comes at a cost and the long-term financial benefit has a large, lagged effect. Hospitals that implement EHR comprehensively are expected to fully return to superior financial performance although an initial decrease in productivity is expected (Fleming et al., 2014). Our findings suggest that hospitals operating in an increasingly competitive market should place greater emphasis on the full adoption of EHR because full adoption of EHR impacts the relationship of quality management with a hospital's financial performance in a beneficial fashion (Zhou et al., 2009).

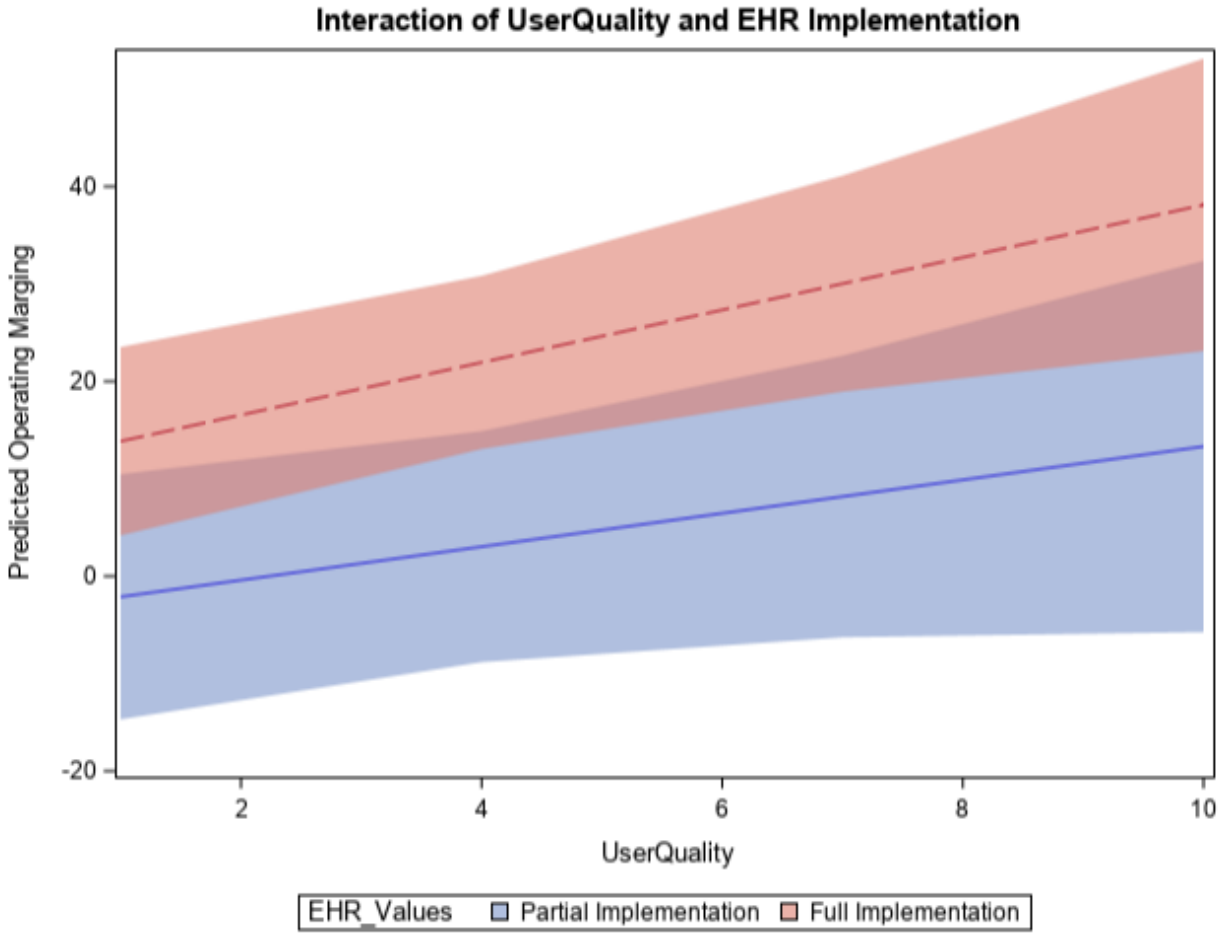

Figure 2. Moderation of EHR Implementation on User Quality in Predicting Operating Margin

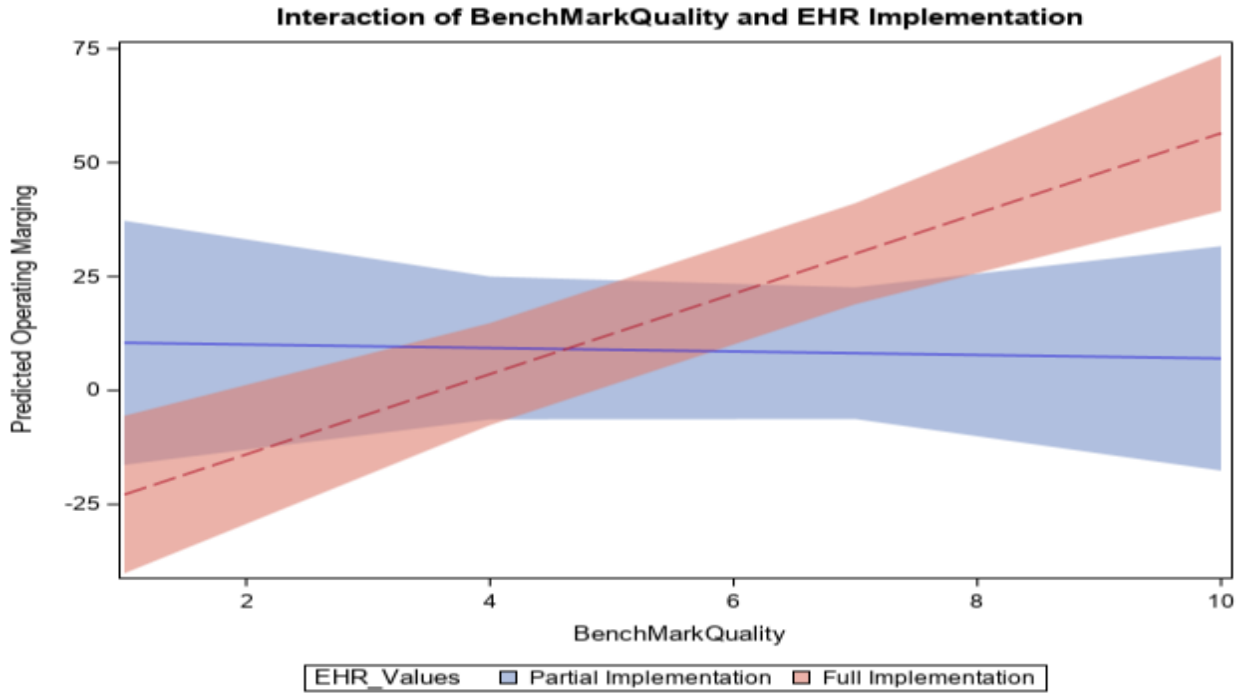

Figure 3. Moderation of EHR Implementation on Benchmark Quality in Predicting Operating Margin

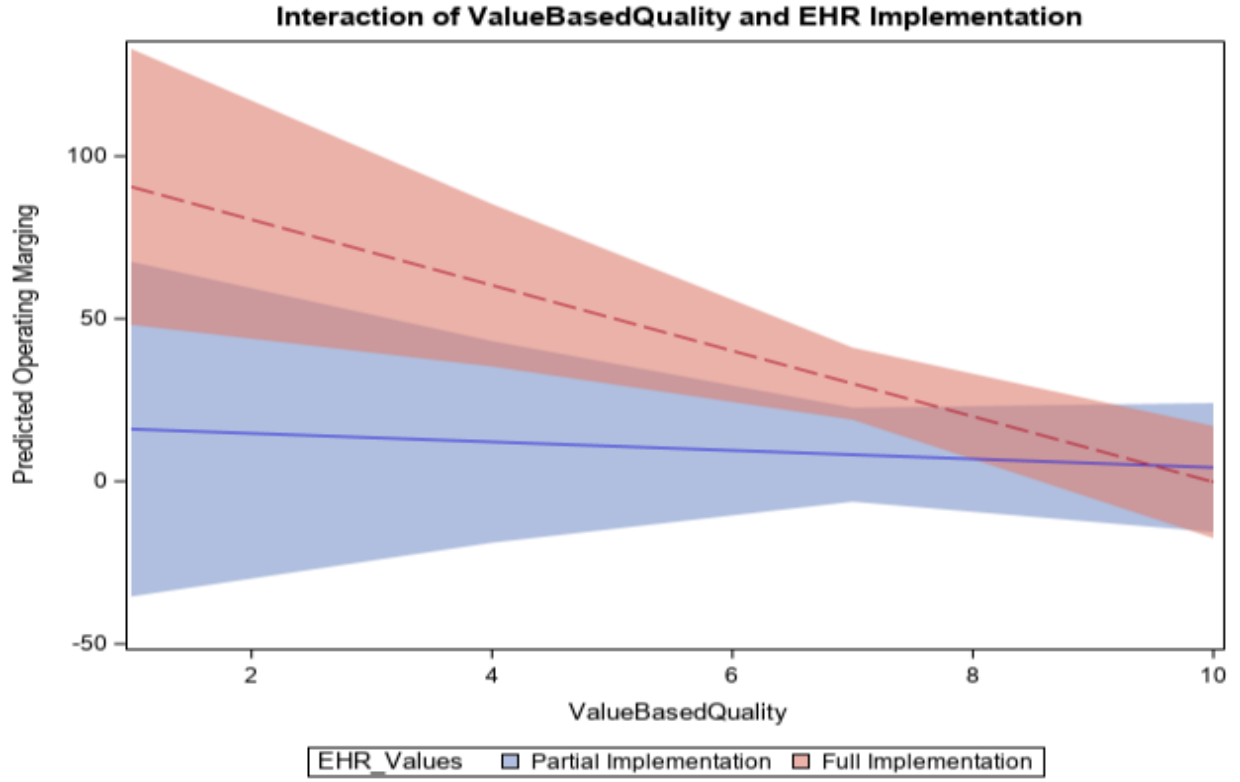

Figure 4. Moderation of EHR Implementation on Value Based Quality in Predicting Operating Margin.

THEORETICAL IMPLICATIONS

This study fills a gap in the existing literature since there is limited work that integrates quality of care and EHR implementation to examine their roles in improving financial performance. Our study contributes to the literature on marketing and healthcare in several ways. Drawing upon the resource advantage theory, we developed a parsimonious framework to investigate the relationship between levels of implementation of EHR and quality of care and their impacts on financial performance. The empirical findings of this study support the conceptual arguments from scholars (Hunt & Morgan, 1997). who suggested that the resource advantage theory contributes to explaining the superior productivity of firms in market-based economies. They argued that rewards will flow to those firms (and to their owners, managers, etc.) that engage in discovery, creation, or assembling of resource assortments that enable the firms to efficiently and effectively produce valued market offerings. Although the impact of EHR and quality of care has been studied (Chaudhry et al., 2006), our study is unique in that it explores the moderating role of EHR implementation on the relationships of quality management and financial performance relationship using operating margin. The effect of EHR implementation on quality measures as they impact financial performance is not well understood. This study provides insights not previously explored in the literature.

MANAGERIAL IMPLICATIONS

EHR implementation is a powerful system that can optimize the management of health-related information. The managerial implications of this study should be heeded. First, according to the resource advantage theory, it is important for firms to fully adopt EHR and exploit their functional capabilities to achieve competitive advantages and superior financial performance. Thus, hospital administrators are encouraged to improve their quality of care by adopting EHR fully. Second, it is important for hospital administrators to understand the relationship between financial performance and EHR implementation. This relationship has been studied and it is noted that: "The key, however, is understanding how elements interact with multiple levels of data needed to achieve the organization's various goals" (Burton-Jones & Volkoff, 2017). Our results suggest that the role of EHR implementation as a moderator of quality management and financial performance is intriguing and conditional on the level of quality. An important insight is that EHR implementation helps to leverage the benefits of quality measures in a hospital system. In the year 2018, technology giants like Amazon and Apple have started entering the field of healthcare through EHR. Apple is planning to integrate EHR records in iPhones and Amazon has started selling EHR mining software. These competitive forces reinforce the imperative for hospitals' administrators to understand the role of EHR in attaining better holistic hospital management, and financial, performance, and patient outcomes.

CONCLUSION AND FURTHER DISCUSSION

Drawing upon resource advantage theory, we have developed a framework that examines the relationships among EHR, quality of care, and financial performance in a hospital. Our structural model has suggested that EHR has a significant positive effect on quality of care that translates into a positive association with financial performance. More specifically, EHR implementation moderates the relationship of total quality management policies and practices with financial performance. The findings of this study also provide practical insights for hospital managers to consider when they are adopting and implementing EHR to achieve superior financial performance. More specifically, this study provides managerial guidelines for managers to understand how different quality metrics and

the type of implementation of EHR influences profitability and the need for a lag in time to recognize improved financial performance.

This study has some limitations. Using a framework consistent with resource advantage theory, we tested the proposed hypotheses using archival data. However, such secondary data do not provide insights into the actual transformation process on how different hospitals have assimilated these constructs into their business process. Survey-based research or research that combines survey data and archival data may generate an in-depth understanding of the process. Thus, future research may collect primary data using questionnaires and also confirm the results obtained in this study. In addition, we only used archival data from Texas hospitals. Although these data provide a good representation of the medical environment in the USA and socio-economic factors, they are a representative sample of a complex medical environment in the USA that may vary by state. Hence generalizability is a limitation. Further, standardization of metrics is very difficult in a complex dynamic environment like healthcare. Therefore, this study included hospitals that are participating in value-based purchasing program setup by Center of Medicare and Medicaid (CMS) and analyzed performance metrics used by CMS for reimbursement. Unfortunately, this excludes many chronic care hospitals and small rural hospitals that do not participate in such a quality improvement program. Hence, future research can include empirical investigation of this model in chronic care and rural hospitals.

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APPENDIX

2016 AHA ANNUAL SURVEY

2016 Annual Survey of Hospitals

25-11006 **Eid Number:** _____

Texas Dept of State Health Services

Hospital Name

Address

City **County** **Zip**

Center for Health Statistics
Hospital Survey Unit
1100 West 49th Street
PO Box 149347
Austin, Texas 78714-9347

Phone (512) 776-7261
Fax (512) 776-7344

The 2016 Cooperative Annual Survey is enclosed. This survey represents the thirty-second year of cooperation between the Department of State Health Services (DSHS), the American Hospital Association (AHA), and the Texas Hospital Association (THA). In an effort to reduce the reporting burden on Texas hospitals, DSHS and AHA have combined their annual survey into a single questionnaire.

The 2016 DSHS/AHA/THA Annual Survey of Hospitals is available online! We recommend that you use this web-based tool **(click on www.ahasurvey.org or www.dshs.state.tx.us/chs/hosp/)** as it will enable you to submit data online making it easier and more efficient for you to respond.

State laws (Health and Safety Code, Chapters 104 and 311) require the Department of State Health Services to collect aggregate financial, utilization, and other data from all licensed hospitals. The survey also incorporates some data components used to determine which hospitals qualify for the Medicaid Disproportionate Share Hospital Program. Therefore, it is extremely important that all sections of the survey be completed fully and accurately.

This survey provides the state's only comprehensive source of information on issues such as uncompensated care and hospital utilization trends. The survey findings are used by legislators, state agencies, and research institutions to support the development of health policy and accompanying programs. The survey also provides data for AHA and THA to assess the current status of the hospital industry and to enable them to provide effective representation and advocacy.

ALL HOSPITALS ARE REQUIRED TO SUBMIT THE SURVEY DATA WITHIN 60 DAYS OF RECEIPT OF THIS SURVEY FORM. Your **timely** completion of this Annual Survey will fulfill your reporting obligation under Texas statutes. It will also ensure the inclusion of your facility's utilization data in **The AHA Guide** for 2016.

Please read the instructions for completion carefully. If you have any questions, please contact the Department of State Health Services, Center for Health Statistics, Hospital Survey Unit at (512) 776-7261 (email address: dwayne.collins@dshs.state.tx.us). Thank you for your cooperation.

Dr. John Hellerstedt
Commissioner
Department of State Health Services

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