Resource-based view on safety culture's influence on hospital performance: The moderating role of electronic health record implementation

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Background: Patient safety and safety culture have received increasing attention from agencies such as the Agency of Healthcare Research and Quality and the Institute of Medicine. Safety culture refers to the fundamental values, attitudes, and perceptions that provide a unique source of competitive advantage to improve performance. This study contributes to the literature and expands understanding of safety culture and hospital performance outcomes when considering electronic health record (EHR) usage.
Purpose: Based on the resource-based view of the firm, this study examined the association between safety culture and hospital quality and financial performance in the presence of EHR.
Methodology/Approach: Data consist of the 2016 Hospital Survey on Patient Safety, Hospital Compare, American Hospital Association's annual survey, and the American Hospital Association's Information Technology supplement. Our final analytic sample consisted of 154 hospitals. We used a two-part nested regression model approach.
Results/Conclusion: Safety culture has a direct positive relationship with financial performance (operating margin). Furthermore, having basic EHR as compared to not having EHR further enhances this positive relationship. On the other hand, safety culture does not have a direct association with quality performance (readmissions) in most cases. However, safety culture coupled with basic EHR functionalities, compared to not having EHR, is associated with lower readmissions.

Key words: EHR, hospital performance, safety culture

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Practice Implications: Hospitals should strive to improve patient safety culture as part of their strategic plan for quality improvement. In addition, hospital managers should consider implementing EHR as a resource that can support safety culture's effect on outcomes such as financial and quality performance indicators. Future studies can examine the differences between basic and advanced EHR presence in relation to safety culture.

Patient safety has been gaining interest among researchers, practitioners, and policymakers in recent years (Shekelle at al., 2013). Recent studies have indicated that there are approximately 400,000 deaths per year due to medical errors (Makary & Daniel, 2016), which is about four times the estimated number of deaths (98,000) given by the Institute of Medicine (Brennan, 2000). Adverse medical events are also associated with high costs, complications, and unnecessary readmissions (Zaheer, Ginsburg, Chuang, & Grace, 2015). Integral to the issue of adverse medical events is safety culture, which refers to shared organizational values about those aspects of work that are important and the beliefs about how things do and should operate, which produce behavioral norms that promote safety (Singer, Lin, Falwell, Gaba, & Baker, 2009). Safety culture is at the core of improving patient safety because a change in values, attitudes, and perceptions is one of the first milestones in achieving better outcomes (Meddings et al., 2016; Mardon, Khanna, Sorra, Dyer, & Famolaro, 2010). For instance, prior studies have shown that a safe culture is related to reduced infections, lower rates of adverse events, decreased readmission rates, and cost savings (Hansen, Williams, & Singer, 2011; Mazurenko, Richter, Kazley, & Ford, 2017; Meddings et al., 2016; Singer et al., 2009).

Adoption of health information technology spurred from the issue of patient safety and is considered a national health policy priority (Adler-Milstein et al., 2015). Health information technology, including electronic health records (EHRs), has the potential to improve outcomes in the form of efficient processes, reduced errors, and high cost savings (Parente & McCullough, 2009; Swanson Kazley & Diana, 2011). The direct benefits of EHR on hospital quality and financial performance have been highlighted (Menachemi, Burkhardt, Shewchuk, Burke, & Brooks, 2006; Swanson Kazley & Diana, 2011). However, the impact of EHR is not limited to its potential direct effects on performance. EHR may also influence performance by supporting a hospital's safety culture. EHR supporting mechanisms can include (a) enhanced communication and feedback, which can result in better coordination across multidisciplinary teams from different units (Fan et al., 2016); (b) more comprehensive discharge summaries given the structured nature of the information collected, which can enhance handoffs and care transitions (Kutney-Lee & Kelly, 2011); and (c) possible reduction in human errors often caused by handwriting and misinterpretation, which can assist management in the distinction between blameless (e.g., those which are faultless or irreproachable) and blameworthy (e.g., those which are culpable or chargeable) acts (Dekker, 2016; Hellings, Schrooten, Klazinga, & Vleugels, 2007; Jha et al., 2009).

Despite research that shows the influence of EHR on patient safety and hospital performance, there is a lack of studies examining how EHR implementation may moderate the relationship between safety culture and hospital performance. Given the increasingly competitive environment in which hospitals operate as well as the increasing use of EHR technology (Adler-Milstein et al. 2015), the results of this study offers a more nuanced understanding of these relationships. Also, it is pertinent to note that most of the prior literature on EHR and patient safety has focused on quality rather than financial performance whereas this study examines both quality and financial performance, thereby making this study unique in its orientation. Therefore, the purpose of this study is to examine the relationship between safety culture and hospital quality and financial performance and to understand how EHR implementation may serve as a moderator of this relationship.

Theoretical Framework

Resource-Based View

The conceptual framework for this article draws on the resource-based view (RBV) of the firm to examine the relationship between safety culture, hospital performance, and EHR implementation. The RBV portrays an organization as a bundle of resources (Chan, Shaffer, & Snape, 2004). Specifically, the RBV posits that the exploitation of valuable, rare, and imperfectly imitable resources forms the basis of value creation, which contributes to a firm's competitive advantage (Barney, 1991). Resources are factors that a firm controls and manages to use and dispose in a way to create value (Barney, 1991; Barney & Clark, 2007). Resources are also considered strengths that help the organization compete and accomplish its mission and goals (Porter, 1985).

Of relevance to this study are resources in the form of both tangible and intangible assets. Although some resources are tangible assets (e.g., equipment, facilities, nurses), others are intangible assets (e.g., skills, knowledge,

efficient procedures, and practices). Tangible assets, such as EHR implementation, are technological resources that support patient safety culture. Intangible assets, such as efficient teamwork, communication, feedback mechanisms, reporting of events, and nonpunitive response to error, are a hospital's strengths in the area of patient safety. These assets form the building blocks of a safety culture that assists hospitals in achieving their strategic goals of improving patient safety and ultimately performance.

Safety Culture as Competitive Advantage and Hospital Performance

Competitive advantage is defined as a value creating strategy that is not simultaneously being employed by a firm's competitors and is thus tied to superior performance (Barney, 1991; Porter, 1985). RBV suggests that culture, which is typically characterized by a set of strong core values, is valuable, rare, and imperfectly imitable. The culture of an organization serves to mobilize, allocate, and leverage assets to achieve a firm's goals. For hospitals, safety culture—in itself—is such a resource. Safety culture is composed of values, perceptions, and behaviors that determine an organization's safety management.

The following attributes of safety culture as a resource reveal its conceptual breadth even further. First, safety culture is valuable because it enables hospitals to prevent adverse events, unnecessary readmissions, and complications, which otherwise would incur high costs to hospitals (Singer et al., 2009). Second, safety culture is a rare attribute because, as evidenced by the Agency for Healthcare Research and Quality's report, there are a limited number of hospitals that are actively involved in developing a safety culture (Famolaro et al., 2016). Finally, safety culture is imperfectly imitable because it is formed by employees' skills and competencies, their beliefs, and tacit knowledge (Fiol, 2001). Because culture is inherently complex, tacit, and specific to organizations, it is extremely difficult to copy or duplicate (Gregory, 1983). Thus, it has the potential to create competitive advantage and can be linked with superior performance (Miles, 2012).

Safety culture also has financial implications in at least two ways. First, studies have shown that safety culture is related to a reduction in adverse events, which in turn has the potential to achieve cost savings (Cohen et al., 2010). Second, safety culture, as a competency that encompasses employees' skills and behaviors, can enhance the hospital reputation. This can, in turn, serve as a source of competitive advantage by uniquely positioning a hospital against its competitors and improving its market share, which can ultimately result in increased revenues (Fiol, 1991, 2001). Therefore, we hypothesize the following:

H1a: *A higher degree of safety culture is positively related to hospital quality performance.*

H1b: *A higher degree of safety culture is positively related to hospital financial performance.*

EHR Implementation and Hospital Performance

According to RBV, resources and capabilities controlled by an organization underlie the performance difference across organizations (Barney, 1991; Barney & Clark, 2007). Superior resources, like technology, enable organizations to perform better in terms of outcomes (Miles, 2012). Research has shown that technology resources, for instance, information and imaging technology, are positively related to firm's performance (Ray, Barney, & Muhanna, 2004). Studies have highlighted the link between EHR adoption and desirable quality outcomes (Menachemi, Chukmaitov, Saunders, & Brooks, 2008; Swanson Kazley & Diana, 2011) and better financial outcomes (Menachemi et al., 2006). In addition, technology that aligns safety culture would be organizationally embedded and therefore consistent with RBV in that it would be difficult to imitate.

Because EHR implementation is a technological resource that may improve both financial and quality outcomes, hospitals invest to acquire this resource. A basic EHR implementation has been shown to have a significant effect on increased quality improvement in acute myocardial infarction (AMI) and heart failure (HF) rates (Jones, Adams, Schneider, Ringel, & McGlynn, 2010). Advanced EHR implementation has the greatest payoff in improving clinical processes of care (Jarvis et al., 2013). EHR's potential to lower administrative costs and hospital cost savings due to EHR are major points in the business case for EHR investment and adoption. Therefore, we suggest the following:

H2a: *EHR implementation is positively related to hospital quality performance.*

H2b: *EHR implementation is positively related to hospital financial performance.*

EHR Implementation as a Moderator of the Relationship Between Patient Safety Culture and Performance

EHR can support a safety culture through several mechanisms. First, EHR implementation provides clinical documentation, which may eliminate human errors that may otherwise be caused by entering and retrieving information on paper records (Jha et al., 2009). A lower likelihood of human errors aids the demarcation between blameless versus blameworthy acts, a necessary element of safety culture (Dekker, 2016; Hellings et al., 2007). Second, multiple interdisciplinary users can use EHR at the same time. Therefore, it can enhance communication and coordination among team members across hospital units

and also within individual units, which are necessary attributes of safety culture (Fan et al., 2016). Finally, EHR implementation provides standardized protocols that can improve care pathways, which allow people to frequently, timely, and accurately communicate to coordinate and solve problems (Gittell, 2002). Standardization of work and consistency of information across the board creates the context needed to bolster the effectiveness of safety culture so that employees can pay closer attention to safety threats (Vogus & Sutcliffe, 2007). This may in turn improve hospital performance, visible in the form of greater access to patient information, reduced reliance on memory regarding patient information, and increased vigilance, which have the potential to make handoffs and transitions seamless and smoother (Kilbridge & Classen, 2008). Because EHR implementation as a technological resource has the potential to augment a hospital's safety culture to achieve superior performance, we suggest the following hypotheses:

H3a: *EHR implementation strengthens the positive relationship between safety culture and hospital quality performance.*

H3b: *EHR implementation strengthens the positive relationship between safety culture and hospital financial performance.*

Methods

Data

This study uses the following data sets for 2014–2015: (a) the Hospital Survey on Patient Safety Culture (HSOPSC) data set from the Agency for Healthcare Research and Quality, (b) the American Hospital Association's (AHA) annual survey data, (c) the AHA's Information Technology (IT) supplement, (d) the Area Health Resource File (AHRF), (e) Hospital Compare database from the Centers for Medicare & Medicaid Services, and (f) Medicare cost reports. The 2016 HSOPSC database is a pooled cross-sectional data set that contains data from years 2014 and 2015. Approximately 680 hospitals administered and submitted results in this database. Of these, 207 provided identifiable information for research purposes.

Sample

We merged data from HSOPSC, AHA annual survey, AHA IT supplement, AHRF, and Hospital Compare to obtain a final analytic sample of 167 hospital observations for AMI, 162 hospital observations for HF, and 166 hospital observations for pneumonia (PN). Next, we merged data from HSOPSC, AHA annual survey, AHA IT supplement, AHRF, and financial data from the Medicare cost reports to obtain a final analytic sample of 154 hospitals for each financial performance indicator. Each of the observations was unique, and there were no repeated measures.

Dependent Variables

We focus on two dimensions of performance: quality performance and financial performance. For quality performance, we use 30-day risk-adjusted readmission rates for AMI, HF, and PN. Thirty-day readmissions are estimates of unplanned readmissions to a hospital within 30 days of discharge from a hospitalization. Readmission rates are risk-adjusted for patient risk factors. Although prior research has shown that hospital patient safety culture is associated with lower readmission outcomes (Hansen et al., 2011), this study makes a contribution by examining the joint effects of patient safety culture and EHR implementation on readmissions. To measure financial performance, we use operating margin to account for profitability through hospital operations, defined as

Operating Margin = (Operating Revenue − Operating Expenses / Operating Revenue) * 100.

Independent Variables

The main independent variables are safety culture and EHR implementation. We use safety culture perceptions as a proxy to measure safety culture. Safety culture perceptions are measured by the positive composite score on the dimension "overall perceptions of safety" from the HSOPSC data (Blegen, Gearhart, O'Brien, Sehgal, & Alldredge, 2009). This composite consists of the following four items: (a) It is just by chance that more serious mistakes don't happen here, (b) Patient safety is never sacrificed to get more work done, (c) We have patient safety problems in this unit, and (d) Our procedures and systems are good at preventing errors from happening. For each item in the composite, we divide the number of positive responses by the total number of responses and get a percentage of positive scores. Then, we average the percent positive response for all items to get the hospitals' composite score.

We assess both the direct effect of EHR implementation on performance as well as its moderating effect. Moderation is assessed as an interaction term of patient safety and EHR implementation. Consistent with prior research, EHR implementation is measured by using three categories: no EHR, basic EHR, and advanced EHR (Jha et al., 2009). Hospitals that belong to the "no EHR" category have not implemented any EHR. Hospitals that belong to the "basic EHR" category have implemented basic functionalities of EHR such as electronic requirement clinical documentation and test and imaging results. These functionalities are from 8 to 10 in number. Hospitals that have "advanced EHR" implementation have implemented EHR comprehensively (e.g., decision support system and computerized physician order

entry in addition to the basic functionalities), and the maximum number of functionalities in this category is 23.

Control Variables

The following organizational level variables were used as controls in the study: (a) Ownership status: not-for-profit (ref), for-profit, government nonfederal; (b) Size: small (0–99 beds [ref]), medium (100–299 beds), and large (300 and above beds); (c) Teaching status: teaching (ref) and nonteaching (hospitals were coded as "teaching" if they were members of the Council of Teaching Hospitals, if they were affiliated to a medical school, or if they provided a residency program); (d) System membership: system affiliated (ref) and non-system-affiliated; and (e) Payer mix: proportion of Medicare patients (Hospital Medicare inpatient days / Hospital inpatient days * 100) and proportion of Medicaid patients (Hospital Medicaid inpatient days / Hospital inpatient days * 100).

Market characteristics as controls include competition, location, and per capita income. Market competition consisted of the Hirschman–Herfindahl Index (HHI; values ranged from 0 to 1; 1 indicates monopolistic market, and values close to 0 indicate highly competitive markets). Market was defined as the particular health services area that the hospital belongs to. To calculate the HHI, we used a two-step approach: (a) Market share = (Inpatient days for hospital X / total inpatient days for all hospitals in the market) and (b) Sum of square of market shares for each market = (Σ(Market share)^2). Location was considered in the following categories: (a) metro (population of 250,000 to 1 million+ (ref)), (b) urban (population of 2,500–20,000), and (c) rural (less than 2,500 population). Finally, per capita income in the county was used as a proxy for socioeconomic status of the population. For both location and per capita income, market was defined as the county in which the hospital is located.

Analytic Approach

We tested our hypotheses using nested multiple regression models: (a) reduced model with main effects and (b) full model with interaction effects. First, only the independent variables and control variables were added in the reduced model with main effects. Next, the full model using independent variables, the interaction term, and control variables was analyzed. Our research model is as follows: $Y_{(performance)} = \beta_0 + \beta_1$ safety_culture $+ \beta_2$ EHR_implementation $+ \beta_3$ safety_culture * EHR_implementation $+ \beta_4$ control variables; where Y = performance, $\beta 0$ = constant, $\beta 1$ = coefficient of safety culture, β_2 = coefficient of EHR implementation, β_3 = interaction term (safety culture * EHR implementation), and β_4 = coefficient of control variables.

To adjust for potential nonresponse bias of hospitals participating in the HSOPSC, we adjust responses by using propensity score weights in the regression analysis. First, a propensity matching score was generated on the basis of following variables that were found significantly different between hospitals that participated in HSOPSC and those who did not: (a) location, (b) ownership, (c) teaching status, (d) system membership, and (e) size. Then, a propensity weight was generated by getting the inverse of propensity scores for hospitals that submitted the survey responses.

Table 1

Descriptive characteristics of all variables in the sample (N = 207)

Dependent variables	Mean	*SD*
AMI 30–day readmission rate	16.79	0.89
HF 30–day readmission rate	21.56	1.37
PN 30–day readmission rate	16.94	1.31
Operating margin	0.63%	0.12%
Independent variable		
Safety culture	67.1%	9.3%
Moderator	**Frequency**	**%**
EHR implementation		
No EHR (ref)	22	10.6%
Basic EHR	103	50.2%
Advanced EHR	81	39.1%
Controls	**Frequency**	**%**
Organizational characteristics		
Ownership		
Not for profit (ref)	160	77.6%
For profit	6	2.9%
Government nonfederal	40	19.4%
Size		
Small (ref)	91	44.1%
Medium	54	26.2%
Large	61	29.6%
Teaching status		
Teaching (ref)	111	53.8%
Nonteaching	95	46.0%
System affiliation		
System (ref)	136	66.0%
Nonsystem	70	33.9%
	Mean	***SD***
Proportion Medicaid population	20.81	37.94
Proportion Medicare population	51.42	42.73
Market characteristics	**Frequency**	**%**
Location		
Metro (ref)	144	69.9%
Urban	59	28.6%
Rural	3	1.4%
	Mean	***SD***
Market competition (HHI)	0.60	0.36
Per capita income (in 1,000s)	44.08	11.59

Note. AMI = acute myocardial infarction; HF = heart failure; PN = pneumonia; EHR = electronic health record; HHI = Hirschman–Herfindahl Index.

Results

Table 1 presents descriptive statistics. The average 30-day readmission rate for AMI (16.79) is lower than that of HF (21.56) and PN (16.94). The mean operating margin for hospitals in our sample was 0.63%. The average percent positive score for safety culture was 67.1%. Almost half of the hospitals in our sample had basic EHR implementation (50.2%), followed by advanced EHR implementation (39%). Approximately 11% of the hospitals did not have any EHR implementation. These results are consistent with previous findings on EHR implementation (Adler-Milstein et al., 2015).

The controls included were organizational and market characteristics of hospitals. Most of the hospitals in our sample were not for profit (77.6%), small (44.1%), teaching (53.8%), and system-affiliated (66%). Among market characteristics, more than half of the hospitals were in a metropolitan location, followed by hospitals in an urban location (~30%). The mean level of market competition, as measured by the HHI, was 0.6, which means they tend to be located in more monopolistic markets. The average per capita income was $44,000.

Contrary to H1a, perceived safety culture was associated with higher readmission rates for AMI, but it was not significantly associated with readmissions for HF or PN. H1b was supported indicating that safety culture was significantly positively associated with financial performance. Specifically, a 10-point increase in the safety culture score is associated with a 2.6 percentage point increase in operating margin (Table 2). There was no significant association between EHR implementation and AMI, HF, or PN readmission rates and operating margin, providing no support to H2a and H2b.

H3a was supported with the interaction term showing positive moderation. Specifically, for AMI, for hospitals with basic EHR (compared to not having EHR), a unit increase in safety culture is associated with a 5.5% decrease in 30-day AMI readmission rates. Similarly, for HF, for hospitals with basic EHR (compared to not having EHR), a unit increase in safety culture is associated with an 8.5% reduction in the 30-day HF readmission rates. For PN, both implementation of basic EHR and advanced EHR moderate the relationship between safety culture and hospital performance. For hospitals having basic EHR (compared to not having EHR), a unit increase in safety culture perceptions are associated with a 7.5% reduction in the 30-day PN readmission rates. On the other hand, for hospitals with advanced EHR (compared to not having EHR), a unit increase in safety culture perceptions is associated with an 8.8% reduction in 30-day PN readmission rates. H3b was supported for our financial performance indicator (Table 3), operating margin. The interaction term showed positive moderation. For hospitals that have basic EHR (compared to not having EHR), a 10-point increase in the safety culture score is associated with an increase of 6.7 percentage points in operating margin.

Among control variables, for-profit hospitals compared to not-for-profit hospitals have higher HF and PN readmission rates. For operating margin, hospitals that are teaching and system-affiliated have an advantage over their counterparts. In addition, large and medium hospitals perform financially better than smaller ones.

Discussion

This study tested the main association of safety culture and EHR implementation on quality and financial outcomes and the interaction between technological resource (EHR) and safety culture on performance. Our study's main findings are that safety culture is positively related with financial performance, but not quality performance. In addition, EHR implementation plays a moderating role in the relationship between safety culture and quality and financial performance.

For quality outcomes, results suggest that safety culture and EHR implementation may not be sufficient by themselves to influence readmission rates. Previous studies on the relationship between safety culture and readmission rates have found that a lower safety culture perception is associated with higher readmission rates for AMI and HF (Hansen et al., 2011). In our study, we found the opposite, that is, higher safety culture perceptions are related with higher readmission rates for AMI in the main effects model. The dissimilarity in findings may be due to methodological differences between the two studies. The Hansen et al. (2011) study did not control for market-level factors that may influence readmissions, nor did it adjust for potential sample selection bias. In addition, the observed positive relationship between safety culture and AMI readmissions may be a result of (a) potential endogeneity, where hospitals with higher readmission rates for AMI may engage more in safety culture improvement, or (b) hospitals that have a higher perceived safety culture may get more referrals for AMI, particularly more acute cases. Therefore, cross-sectionally, we may observe a positive relationship between the two, which is a limitation of this study.

On the other hand, our results suggest that a higher safety culture in conjunction with at least basic EHR implementation can result in lower readmissions. EHR may support safety culture in multiple ways. Basic EHR has the potential to support safety culture through its computerized physician order entry for medications and electronic clinical documentation features. The computerized physician order entry for medications can assist in decreasing the incidence of medication errors, which may prevent adverse drug events. The electronic clinical documentation can allow physicians and nurses to view notes about plans of care, which can make handoffs and transitions smoother (Parente & McCullough, 2009). Advanced EHR has the decision support feature that

Table 2

Regression results of the relationship between safety culture and readmission rates with EHR implementation as the moderator (N = ~170)

	AMI 30 day readmission rates		HF 30-day readmission rates		PN 30-day readmission rates	
	Reduced model main effects	Full model interaction effects	Reduced model main effects	Full model interaction effects	Reduced model main effects	Full model interaction effects
	B (*SE*)	*B* (*SE*)	*B* (*SE*)	*B* (*SE*)	*B* (*SE*)	*B* (*SE*)
Safety culture	2.16*	5.11**	0.21	5.66**	1.00	7.67**
	(1.11)	(1.34)	(2.21)	(1.96)	(1.56)	(2.45)
EHR implementation (ref = no EHR)						
Basic EHR	0.18	3.88**	0.38	6.25**	−0.03	5.09*
	(0.28)	(1.41)	(0.38)	(2.05)	(0.33)	(2.14)
Advanced EHR	0.52*	1.84	0.74*	3.59	0.46	6.53**
	(0.26)	(1.55)	(0.35)	(2.81)	(0.34)	(2.09)
Safety culture * EHR implementation						
Basic EHR		−5.50**		−8.51**		−7.50*
		(2.03)		(2.86)		(3.19)
Advanced EHR		−1.85		−4.04		−8.86**
		(2.38)		(4.10)		(3.06)
Ownership (ref = not for profit)						
Government nonfederal	0.01	0.00	−0.19	−0.16	−0.31	−0.36
	(0.20)	(0.19)	(0.30)	(0.30)	(0.24)	(0.24)
For profit	0.64	0.62	1.27**	1.59**	0.31	0.71*
	(0.33)	(0.32)	(0.39)	(0.39)	(0.34)	(0.29)
Size (ref = small)						
Medium	−0.16	−0.24	−0.21	−0.30	0.50	0.47
	(0.21)	(0.21)	(0.39)	(0.40)	(0.35)	(0.34)
Large	−0.11	−0.19	−0.69	−0.71	0.19	0.09
	(0.25)	(0.25)	(0.42)	(0.40)	(0.35)	(0.35)
Teaching status (ref = No)						
Yes	−0.24	−0.21	0.08	0.08	0.30	0.31
	(0.20)	(0.19)	(0.33)	(0.32)	(0.31)	(0.31)
System membership (ref = No)						
Yes	−0.14	−0.15	0.39	0.39	0.05	0.06
	(0.21)	(0.21)	(0.29)	(0.29)	(0.23)	(0.23)
% Medicaid population	0.01	0.01	0.00	−0.00	0.00	−0.00
	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
% Medicare population	0.01	0.01	−0.00	−0.00	−0.00	0.00
	(0.01)	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)
Location (ref = metro)						
Urban	−0.20	−0.24	−0.05	−0.04	0.12	0.12
	(0.21)	(0.20)	(0.36)	(0.36)	(0.28)	(0.27)
Rural	–	–	−0.53	−0.35	0.88	0.96
			(0.67)	(0.73)	(0.78)	(0.78)
Competition	−0.15	−0.21	−0.19	−0.15	−0.51	−0.35
	(0.29)	(0.29)	(0.48)	(0.51)	(0.42)	(0.43)
Per capita income	4.81e−06	2.92e−06	0.00	8.85e−06	8.32e−06	9.34e−06
	(0.00)	(0.00)	(0.00)	(0.00)	(9.27e−06)	(9.42e−06)

Note. AMI = acute myocardial infarction; HF = heart failure; PN = pneumonia; EHR = electronic health record.

*$p < .05$. **$p < .01$. ***$p < .001$.

Table 3

Regression results of the relationship between safety culture and operating margin with EHR implementation as the moderator (N = 154)

DV = Operating margin	Reduced model main effects *B* (*SE*)	Full model interaction effects *B* (*SE*)
Safety culture	0.26*	−0.18
	(0.13)	(0.17)
EHR Implementation (ref = no EHR)		
Basic EHR	0.01	−0.46
	(0.02)	(0.19)
Advanced EHR	0.03	−0.26
	(0.02)	(0.18)
Safety culture * EHR implementation		
Basic EHR		0.67*
		(0.27)
Advanced EHR		0.40
		(0.25)
Ownership (ref = Not for profit)		
Government nonfederal	−0.00	−0.00
	(0.02)	(0.00)
For profit	0.03	0.04
	(0.02)	(0.00)
Size (ref = small)		
Medium	0.04	0.04*
	(0.02)	(0.02)
Large	0.10**	0.10**
	(0.02)	(0.05)
Teaching status (ref = No)		
Yes	0.05*	0.05*
	(0.02)	(0.02)
System membership (ref = No)		
Yes	0.04*	0.04*
	(0.01)	(0.02)
%Medicaid population	−0.00*	−0.00*
	(0.00)	(0.00)
%Medicare population	0.00	0.00*
	(0.00)	(0.00)
Location (ref = metro)		
Urban	−0.10**	−0.09**
	(0.02)	(0.02)
Rural	−0.34**	−0.34**
	(0.02)	(0.20)
Competition	−0.01	−0.01
	(0.03)	(0.03)
Per capita income	2.62e−07	5.17e−07
	(6.9e−07)	(4.9e-07)

Note. EHR = electronic health record.

*$p < .05$. **$p < .01$. ***$p < .001$.

identifies patients who have a drug allergy or drug–drug interaction and can reduce the chances of human errors, while helping management in the differentiation of acts that were the result of poor decision-making, negligence, or carelessness and those that were purely accidental (Kutney-Lee & Kelly, 2011). Such EHR functionalities can potentially enhance the safety culture, which has the potential to reduce complications and adverse events, thereby reducing readmissions.

For financial performance, results show that safety culture is positively related to better operating margin. It is well established that medical errors may cause a significant financial burden on our health care system (Institute of Medicine, 2006). Superior safety performance by hospitals may be a result of improved safety culture, which also translates to a reduced incidence of medical errors. A decreased occurrence of medical errors may lower the expenditure associated with treating unnecessary complications, which may reduce hospital's financial burden. In addition, hospitals with a reputation for a superior safety performance may attract a higher patient volume, which may then lead to an increase in market share and revenues.

EHR implementation alone did not show a significant positive association with financial performance. It could be because the cost of installation, implementation, and maintenance of sophisticated IT systems can lead to higher technological expenses, particularly up-front. Furthermore, the relationship between EHR implementation and financial performance may vary based on the length of EHR implementation. Because of data limitation, we were not able to account for length of EHR implementation. However, the interaction effects were significant and showed that having at least basic EHR plays a supporting role in the positive relationship between safety culture and financial performance.

Considering EHR implementation in three different categories (no EHR, basic EHR, and advanced EHR) brings a focus on the different kinds of EHR functionalities. Overall, having at least basic EHR enhances safety culture perceptions to improve performance, whereas in a few cases, having more comprehensive functionalities under an advanced EHR also support the safety culture perceptions. In some cases, having advanced EHR was not different from having no EHR. One potential explanation is that hospitals with advanced EHR may experience bigger implementation challenges than those with basic EHR. As a result, they may not be able to reap the full benefits of EHR. In addition, features of basic EHR, with their lack of complexity and ease of implementation, may be more supportive of safety culture practices, thus being more valuable for the hospital.

It is important to acknowledge some limitations and future areas of study. First, the generalizability of our findings may be limited given the small sample size and a cross-sectional analysis. Future research should explore longitudinal designs to examine the relationship between degree of EHR implementation and performance by testing the lagged effects of EHR implementation. Second the degree

to which safety culture perceptions are already positive may be a reason that propels hospitals to take safety culture surveys, which introduces opportunities for examining various associations between safety culture perceptions, mechanisms of EHR usage, and patient safety outcomes, to name a few. Third, although this study assessed degree of EHR implementation, it did not capture duration of time since EHR implementation. Finally, because of data limitations, our study was only able to examine safety culture data aggregated at the hospital level. Future studies should examine how perceptions of safety culture may vary for different types of health care workers and how this may be associated with performance.

Practice Implications

Despite its limitations, this study has important implications for hospitals that are set to prioritize safety culture in their hospitals. In this study, we have used RBV to analyze hospital performance. Competitive advantage includes those competencies that go beyond tangible assets, for instance, employees' behaviors, skills, specializations, and tacit knowledge (Fiol, 1991). Safety culture perceptions are values and beliefs held by employees that are scarce and hard to imitate. Thus, safety culture is a resource for competitive advantage that uniquely positions hospitals to improve their performance. Therefore, health care managers should consider positive safety culture perceptions as a valuable and imperfectly imitable resource that can provide that competitive advantage.

This study documents the relevance of EHR implementation as a technological capability that augments the influence of safety culture perceptions on hospital performance. This may be because EHR implementation allows hospital employees to electronically record key parts of a patient's history, create care summary documents, and implement clinical decision support tool, among other things (Jha et al., 2009). It permits regular and precise communication in support of care coordination, problem solving, and the improvement of care pathways (Gittell, 2002). By increasing access to patient information and reducing the reliance on memory, EHR offers increased vigilance and the potential for seamless handoffs (Kilbridge & Classen, 2008). Employees may be more likely to feel that their organization's culture is safe when the above-mentioned features reduce the potential for human errors. As adverse patient safety events continue to happen and safety culture remains jeopardized, further investigation on this topic is warranted to shed more light on how safety culture can be improved to positively affect hospital performance.

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