Hospital Financial Position and the Adoption of Electronic Health Records

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EXECUTIVE SUMMARY

The objective of this study was to examine the relationship between financial position and adoption of electronic health records (EHRs) in 2,442 acute care hospitals. The study was cross-sectional and utilized a general linear mixed model with the multinomial distribution specification for data analysis. We verified the results by also running a multinomial logistic regression model. To measure our variables, we used data from (1) the 2007 American Hospital Association (AHA) electronic health record implementation survey, (2) the 2006 Centers for Medicare and Medicaid Cost Reports, and (3) the 2006 AHA Annual Survey containing organizational and operational data. Our dependent variable was an ordinal variable with three levels used to indicate the extent of EHR adoption by hospitals. Our independent variables were five financial ratios: (1) net days revenue in accounts receivable, (2) total margin, (3) the equity multiplier, (4) total asset turnover, and (5) the ratio of total payroll to total expenses. For control variables, we used (1) bed size, (2) ownership type, (3) teaching affiliation, (4) system membership, (5) network participation, (6) full-time equivalent nurses per adjusted average daily census, (7) average daily census per staffed bed, (8) Medicare patients percentage, (9) Medicaid patients percentage, (10) capitation-based reimbursement, and (11) nonconcentrated market. Only liquidity was significant and positively associated with EHR adoption. Asset turnover ratio was significant but, unexpectedly, was negatively associated with EHR adoption. However, many control variables, most notably bed size, showed significant positive associations with EHR adoption. Thus, it seems that hospitals adopt EHRs as a strategic move to better align themselves with their environment.

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Healthcare policymakers have pressed hospitals to adopt EHRs. By executive order, the Bush administration established the position of National Coordinator for Health Information Technology in the Department of Health and Human Services to help bring about the broad adoption of health information technology. Later, in the Obama administration, Congress passed the American Recovery and Reinvestment Act of 2009, which set a goal of near-universal utilization of EHRs by the end of 2014 and provided $19.2 billion for health information technology (Steinbrook 2009). As a result, hospitals are facing intense pressure to implement health information technology systems in order to have certified EHRs that fulfill the federal government's definition of meaningful use and thereby avoid substantial financial penalties (Ford et al. 2010).

EHRs have the potential to significantly improve the performance of hospitals. They may lower costs by identifying harmful drug reactions or possible allergic reactions and by facilitating preventive medicine and helping physicians manage patients with complex chronic conditions. They may increase efficiency by eliminating medical transcription and the need to physically pull charts, prompting providers to prescribe generic drugs, and reducing duplication of diagnostic tests (Hillestad et al. 2005).

In spite of the significant benefits likely to flow from the adoption of EHRs, only a small percentage of hospitals have adopted them (AHA 2007; Cutler, Feldman, and Horwitz 2005). The most frequently reported barriers to adoption are financial. The capital requirements are substantial, the positive effect on return on investment is unclear, maintenance costs are high, and the costs of increasing the number of information technology staff are daunting (Jha et al. 2009). Another aspect of the financial barriers is a misalignment of incentives. Hospitals bear the cost of implementing EHRs, but most of the financial benefit from outpatient services accrues to providers and payers (Ash and Bates 2005).

The purpose of this article is to more comprehensively examine the role of the financial position of a hospital in the adoption of EHRs so that we might better understand the barriers to adoption. We attempt to do this by addressing three gaps that we perceive in the literature. One gap is that recent papers have examined some but not all of the major categories of financial ratios in an effort to determine variables associated with the adoption of EHRs. Wang and colleagues (2005) examine government payer mix, return on assets, operating margin, cash flow per bed, days cash on hand per bed, and total operating revenue. Thus, they examine profitability and liquidity ratios, but they do not examine asset turnover or leverage ratios. Menachemi and colleagues (2006) make financial ratios the dependent variable instead of the independent variable. They examine return on assets, cash flow ratio, operating margin, and total margin. Even so, they still leave out the categories of liquidity and leverage. Kazley and Ozcan (2007) examine operating margin and thus only address profitability. Although each of these studies made significant contributions

to the literature, we want to see if a more comprehensive approach to financial position will shed new light on the adoption of EHRs.

Another perceived gap is that not all of the recent studies control for network participation. Wang and colleagues (2005) include network participation, but other studies do not. However, the literature provides clear evidence that network participation can affect the diffusion of innovation (Goes and Park 1997; Young, Charns, and Shortell 2001). Thus, we want to see if the addition of an important control variable will yield new results.

Still another perceived gap is that all of the studies mentioned have focused on identifying linear relationships with financial ratios. There is clear evidence that financial variables of hospitals frequently exhibit curvilinear relationships (Chan, Feldman, and Manning 1999). Thus, we want to see if a different methodological approach will shed new light on the relationship between financial position and the propensity to adopt EHRs.

In short, this paper attempts to contribute to the literature by focusing on all three of the perceived gaps at the same time. We review the literature to develop the conceptual framework for our study. We discuss the definition of EHRs, institutional theory, resource dependence, and the validity of financial and operational ratios to assess hospital performance in order to generate our research hypotheses.

CONCEPTUAL FRAMEWORK

We define EHRs as repositories of patient data in digital form, stored and exchanged securely and accessible by multiple authorized users. They contain retrospective, current, and prospective information. Their primary purpose is to support efficient and quality healthcare. The results are that EHRs improve the completeness and accuracy of patient records. The primary organizational impact is that they improve communication among healthcare professionals (Häyrinen, Saranto, and Nykänen 2008). The EHRs are the primary components of health information technology. A key feature of the EHR is interoperability. Whereas an electronic medical record is organization specific, an EHR may be accessed across systems (Garets and Davis 2006). EHRs have a small but positive effect on quality of care across all types of hospitals, but the positive effect is much greater on academic medical centers because of the greater complexity of medical issues encountered in those hospitals (McCullough et al. 2010).

Institutional theory is an organizational theory perspective that views organizations as manifestations of powerful institutional rules that confer legitimacy (Meyer and Rowan 1977; DiMaggio and Powell 1983). Consistent with institutional theory, pressure from healthcare policymakers forces hospitals to adopt EHRs to preserve their legitimacy. Thus, we would expect many hospitals to adopt EHRs for this purpose, even if there were no market-oriented economic benefits from this change.

Resource dependency is another organizational theory perspective that holds that organizations are not in complete control of the resources they need to survive. They therefore make

conscious strategic decisions to gain or maintain access to those resources (Pfeffer and Salancik 1978). The resource dependence perspective suggests that hospitals would adopt EHRs to ensure patient demand for their services and government reimbursement for those services.

With regard to the validity of financial ratios for the hospital industry, we refer to the work of Pink and colleagues (2005). In their paper they first conducted a literature review to determine the financial and operating ratios showing the most predictive value in empirical studies and then conducted a survey of hospital CEOs to determine the most useful financial ratios for assessing critical access hospitals. The authors concluded that the most important financial and operational dimensions in the Medicare Cost Reports were (1) profitability, (2) liquidity, (3) capital structure, (4) revenue indicators, (5) cost indicators, and (6) utilization indicators. The study reported that CEOs found net days revenue in accounts receivable to be an especially useful measure of liquidity, FTEs per adjusted occupied bed to be an especially useful operational ratio, and total margin to be an especially useful profitability ratio.

In choosing the financial ratios for use as independent variables, we started with the four standard categories of ratios. Based on the work of Pink and colleagues (2005), we used net days revenue in accounts receivable as a liquidity ratio. Mindful of the usefulness of the DuPont method of ratio analysis, we used total margin as a profitability ratio, total asset turnover as an asset management ratio, and the equity multiplier as a leverage ratio (Gapenski 2007). Last, we used the ratio of total payroll to total expenses to measure human resources cost efficiency.

Once again, because the major barriers to adoption of EHRs are financial (Jha et al. 2009), our hypotheses are that hospitals in better financial position with regard to liquidity, profitability, leverage, asset utilization, and human resources efficiency will be more likely to adopt EHRs. Accordingly, we developed the following research hypotheses:

1. The higher the liquidity, the greater the hospital propensity to adopt EHRs.
2. The higher the profitability, the greater the hospital propensity to adopt EHRs.
3. The lower the leverage, the greater the hospital propensity to adopt EHRs.
4. The higher the efficiency in utilizing assets, the greater the hospital propensity to adopt EHRs.
5. The higher the efficiency in utilizing human resources, the greater the hospital propensity to adopt EHRs.

METHODS

Study Design and Data

This was a cross-sectional study, and the unit of analysis was the hospital. The data used were obtained from three sources: (1) the 2007 AHA EHR implementation survey, (2) the 2006 CMS cost reports data, and (3) the 2006 AHA Annual Survey. The three datasets were merged using the Medicare provider

number. We only focused on acute care, short-term stay general hospitals. The AHA EHR survey data included 3,451 hospitals, among which 2,932 were acute, short-term general hospitals. However, the number of usable cases was less than that. Some cases were excluded because the Medicare provider number was missing. Other cases were excluded because the cost report data contained questionable entries. For example, some reported asset values of zero. Further, other cases were excluded because the cost report data contained extreme outliers. As a result of these data exclusions, the final dataset included a total of 2,442 acute care hospitals.

Measures

Our dependent variable was an ordinal variable with three levels used to indicate the level of EHR adoption by the hospitals. The highest level, denoted by the value of 1, represented hospitals that made a comprehensive EHR adoption. The middle level, denoted by the value of 2, represented hospitals that made a basic EHR adoption. The lowest level, denoted by the value of 3, represented the remaining hospitals that did not make even a basic level of EHR adoption. Definitions of comprehensive and basic EHR adoptions were based on the study done by Jha and colleagues (2009).

In conventional mixed model or logistic regression, the response variable is a dichotomous variable. When the response variable has more than two values (e.g., 1, 2, or 3), multinomial distribution is usually specified for measuring the association between the independent reference group variables and the response variables. The odds ratio in multinomial mixed model or logistic regression can be interpreted as the ratio of odds of an event occurring for one level as opposed to another level in the reference group. For example, assume that the level of EHR adoption by hospitals, the response variable, is grouped as three levels from 1 to 3, with 1 being the highest and 3 being the lowest. Assume also that we are interested in comparing the highest level of EHR adoption by hospitals with the lowest level of adoption, and the comparison in the reference group is between small and large hospitals. An odds ratio of 0.50 means that the odds of implementing a higher-level EHR system for small hospitals is half the odds for large hospitals.

The independent variables were the five financial ratios described earlier. Their definitions, coding values, and data sources are listed in Exhibit 1.

We chose our control variables from the ones used by Young, Charns, and Shortell (2001); Wang and colleagues (2005); Kazley and Ozcan (2007); and Jha and colleagues (2009). We also chose control variables from the review of ratios by Pink and colleagues (2005). We grouped the control variables into three categories: structure, operations, and competitive factors. To measure hospital structure, we used bed size, ownership type, teaching affiliation, system membership, and network participation. To measure hospital operations, we used full-time equivalent nurses per adjusted average daily census, and average daily census per staffed bed. To measure hospital competitive factors, we used Medicare patients percentage, Medicaid patients

EXHIBIT 1
Variable Definitions, Coding, and Data Sources

Variable	Coding	Definition	Data Source
Dependent variable			
Level of EHR adoption			2007 AHA EHR Survey
Comprehensive EHR system	1	24 electronic functions present in all major clinical units	
Basic EHR system	2	8 electronic functions present in all major clinical units	
Below basic EHR system	3	None of the above	
Independent variable			
Financial ratios			
Net days revenue in accounts receivable	Quartile 1-4	(Accounts receivable – allowances for bad debts)/ (net patient revenue/365)	2006 CMS
Total asset turnover	Quartile 1-4	Total revenue/total assets	2006 CMS
Total margin	Quartile 1-4	Net income/(net patient revenue + other revenue)	2006 CMS
Equity multiplier	Quartile 1-4	Total assets/fund balance	2006 CMS
Total payroll to total expenses ratio	Quartile 1-4	Total salary expenses/total expenses	2006 AHA
Structure			
Bed size			
< 50 beds	1		2006 AHA
50–199 beds	2		2006 AHA
200–399 beds	3		2006 AHA
≥ 400 beds	4		2006 AHA
Ownership (reference: not for profit)			
Public	1-yes, 0-no	Public hospital	2006 AHA
Investor owned	1-yes, 0-no	Investor-owned, for-profit hospital	2006 AHA
Teaching hospital	1-yes, 0-no	Resident training approved by council of teaching hospitals or member of American Council of Teaching Hospitals	2006 AHA
System member	1-yes, 0-no	Member of a multihospital system	2006 AHA
Network participant	1-yes, 0-no	Participates in a network	2006 AHA

EXHIBIT 1 (continued)

Variable	Coding	Definition	Data Source
Operations			
FTE nurses per adjusted ADC	Quartile 1-4	Number of full time equivalent nurses/adjusted average daily census	2006 AHA
Average daily census per staffed bed	10 percentiles	Average daily census/number of staffed beds: ranked and divided into 10 groups with 10 percentile per group to form an ordinal variable	2006 AHA
Competitive factors			
Medicare patients percentage	Quartile 1-4	Medicare patients/total patients	2006 AHA
Medicaid patients percentage	Quartile 1-4	Medicaid patients/total patients	2006 AHA
Capitation-based reimbursement	1-yes, 0-no	Percent of net revenue paid on a capitated basis greater than zero, percent of net revenue paid on a shared risk basis, or number of lives covered under capitated payment greater than zero	2006 AHA
Nonconcentrated market	1-yes, 0-no	Herfindahl-Hirschmann index based market shares of adjusted admissions. Non-concentrated market means a competitive market or a mildly concentrated market.	2006 AHA

percentage, capitation-based reimbursement, and nonconcentrated market. See Exhibit 1 for the coding values and data sources.

Analytical Techniques

Since there were three levels in the dependent variable level of EHR adoption, we used the general linear mixed model with the multinomial distribution specification for data analysis. To verify our findings, we also applied a multinomial logistic regression model on our data to examine the consistency of the results from the two models. The results obtained from the general linear mixed model and the multinomial logistic model were similar, and thus we only report the results of the general linear mixed model in this article.

Several actions were taken before the multivariable analysis. First, because our dependent variable was a three-level ordinal variable, both the continuous independent variables and some control variables were ranked and converted to quartile scales to create meaningful intervals by which to examine their relationships with the dependent variables. Another reason for putting the independent and control variables into quartiles was that we were mindful of previous research (Chan, Feldman, and Manning 1999) identifying curvilinear relationships with financial variables. We therefore wanted to identify any nonlinear relationships between the predictors and the dependent variable. For the quartiles generated for each of the predictors, three dummy variables were created to represent the top three quartiles. The bottom quartile served as the reference. Second, multicollinearity problems among the predictors were investigated. A high correlation between teaching hospital status and bed size code was detected, and, as a result, only bed size code was retained in the multivariable model. During the preliminary regression analysis for detecting multicollinearity (Allison 2005), we also found multicollinearity between the Medicare patients percentage and the Medicaid patients percentage. Therefore, only the bed size code and Medicare patients percentage variables were kept in our final multivariable model. Finally, due to a relatively small number of hospitals that fully implemented the comprehensive EHR system, we collapsed bed size code from the original eight levels to four levels.

RESULTS

Unadjusted descriptive results are displayed in Exhibit 2. The bivariate analysis showed a significant relationship between the level of EHR adoption and four of the five financial indicators. It seems that a high level of EHR adoption was associated with a lower total asset turnover (1.01, 1.07, and 1.28 for the three levels of EHR adoption). A higher level of EHR adoption was also associated with a higher level of total margin (0.08, 0.06, and 0.04 for the three levels of adoption). For the net days revenue in accounts receivable and the total payroll to total expenses ratios, the relationships of the quartiles to the EHR adoption varied. Three of the five hospital structure variables—bed size, ownership type, and teaching hospital status—were significantly related to EHR adoption. Both hospital operation variables were significantly associated with the EHR adoption, whereas only one of the four hospital environment variables, located in nonconcentrated market, was significantly associated with the EHR adoption.

Results of covariate-adjusted multivariable analysis are shown in Exhibit 3. Only two of the five financial indicators, net days revenue in accounts receivable and total asset turnover, demonstrated significant negative association with the level of EHR adoption. For net days revenue in accounts receivable, as compared with the first quartile (i.e., fewest days revenue in accounts receivable), hospitals in the second quartile were less likely to implement a higher level EHR system (odds ratio [OR] [CI (95% confidence interval)], 0.66 [0.47, 0.93]),

EXHIBIT 2
Characteristics of Hospitals by Level of EHR Adoption (n = 2,442)

Variable	Full Adoption (n = 33)	Partial Adoption (n = 280)	Non-Adoption (n = 2,129)	
Financial Ratios				
Net days revenue in accounts receivable	81.20 (90.74)	53.60 (28.70)	58.21 (32.66)	**
Total asset turnover	1.01 (0.71)	1.07 (0.66)	1.28 (1.02	**
Total margin	0.08 (0.10)	0.05 (0.07)	0.04 (0.09)	**
Equity multiplier	2.34 (4.35)	1.60 (6.44)	1.88 (9.08)	
Total payroll to total expenses ratio	0.43 (0.06)	0.41 (0.07)	0.43 (0.07)	**
Structure				
Bed size, %				***
< 50	24.24	12.14	29.83	
50–199	27.27	36.79	40.54	
200–399	24.24	29.29	20.29	
≥ 400	24.24	21.79	9.35	
Ownership, %				***
Public	39.39	17.14	25.6	
Not for profit	54.55	76.36	63.5	
Investor owned	6.06	7.50	10.9	
Teaching hospital %	36.36	32.5	18.74	***
System membership %	57.58	53.57	49.98	
Network participant %	48.48	36.79	39.88	
Operations				
FTE nurses per adjusted ADC	1.46 (0.55)	1.42 (0.52)	1.31 (0.75)	**
Average daily census per staffed bed	0.62 (0.17)	0.64 (0.17)	0.57 (0.20)	**
Competitive Factors				
Medicare patients percentage	47.25 (20.44)	49.16 (15.00)	50.00 (20.28)	
Medicaid patients percentage	20.69 (21.76)	18.47 (14.49)	19.40 (17.56)	
Capitation-based reimbursement	12.12	16.79	12.35	
Nonconcentrated market	24.24	24.64	15.78	***

Data are expressed as mean (standard deviation) unless otherwise indicated.
** $p < 0.05$, *** $p < 0.01$

EXHIBIT 3
Relationships Between Financial Ratios and the Level of EHR Adoption (n = 2,442)*

Independent Variable	Odds Ratio	95% CI	p-Value
Financial Ratios			
Net days revenue in accounts receivable (reference : 1st quartile – fewest net days revenue in accounts receivable)			
- 2nd quartile	0.66	[0.47, 0.93]	0.017
- 3rd quartile	0.76	[0.54, 1.06]	0.107
- 4th quartile	0.72	[0.50, 1.04]	0.077
Total asset turnover (reference: 1st quartile – lowest total asset turnover)			
- 2nd quartile	0.75	[0.54, 1.04]	0.085
- 3rd quartile	0.65	[0.46, 0.93]	0.017
- 4th quartile	0.51	[0.34, 0.76]	0.001
Total margin (reference: 1st quartile – lowest total margin)			
- 2nd quartile	1.01	[0.69, 1.48]	0.966
- 3rd quartile	1.03	[0.70, 1.51]	0.877
- 4th quartile	1.17	[0.80, 1.71]	0.416
Equity multiplier (reference: 1st quartile – lowest equity multiplier)			
- 2nd quartile	0.95	[0.66, 1.39]	0.804
- 3rd quartile	0.83	[0.56, 1.21]	0.331
- 4th quartile	0.86	[0.59, 1.24]	0.415
Total payroll to total expenses ratio (reference: 1st quartile – lowest total payroll to total expenses)			
- 2nd quartile	0.92	[0.66, 1.28]	0.619
- 3rd quartile	0.73	[0.51, 1.05]	0.094
- 4th quartile	0.87	[0.60, 1.27]	0.467
Significant control variables			
FTE nurses per adjusted ADC (reference: 1st quartile – fewest FTE nurses per adjusted ADC)			
- 2nd quartile	1.60	[1.05, 2.46]	0.030
- 3rd quartile	1.55	[1.00, 2.39]	0.048
- 4th quartile	1.87	[1.21, 2.89]	0.005
Bed size (reference: 1st quartile – smallest bed size hospitals)	1.17	[1.07, 1.28]	0.001
Average daily census per staffed bed (reference: 1st quartile – lowest average daily census per staffed bed)	1.10	[1.00, 1.20]	0.035

* Except for the financial indicators, only significant results of control variables are listed.
FTE: full-time equivalent, ADC: adjusted daily census

and hospitals in the fourth quartile and third quartile were marginally less likely or close to marginally less likely to implement a higher-level EHR system.

The association between the quartiles of total asset turnover and the level of EHR adoption was a stable negative trend. As compared with hospitals in the first quartile (in terms of lowest total asset turnover), hospitals in the second, third, and fourth quartiles were all marginally less likely to implement a higher-level EHR system (ORs [CIs], 0.75 [0.54, 1.04], 0.65 [0.46, 0.93], and 0.51 [0.34, 0.76], respectively).

As for the control variables, three showed significantly positive relationships with the level of EHR adoption. For the number of FTE nurses per adjusted average daily census, as compared with the hospitals in the first quartile (fewest FTE nurses per adjusted average daily census), the odds ratios of the second and third quartiles were similarly higher (1.60 and 1.55, respectively), and the odds ratio of the fourth quartile was even higher (1.87 with a CI of 1.21, 2.89). Finally, for every increase in one level of average daily census per staffed bed, the odds of implementing a higher level EHR adoption increased by 10 percent. For every one-level increase in bed size, the odds of implementing a higher level EHR system increased by 17 percent (OR [CI], 1.17 [1.07, 1.28]).

DISCUSSION

With regard to the second, third, and fifth research hypotheses concerning profitability, leverage, and efficient utilization of human resources, after controlling for structure, operations, and competitive factors, none of the relationships were significant. Thus, these ratios were not associated with EHR adoption in our study. The results of our study are consistent with Kazley and Ozcan (2007), who found that operating margin was not associated with EHR adoption. Our results are also consistent with Wang and colleagues (2005), who found that IT adoption strategies are not associated with return on assets. However, our results are in contrast to Wang and colleagues' (2005) finding that hospitals with robust revenue and cash flow have the resources to fund the adoption of information technology. However, although their dataset was from a national sample, it was from 1998, making it much older than ours. Our results also contrast with Menachemi and colleagues (2006), who found that total margin and operating margin had a significant positive relationship to IT adoption. However, it should be noted that their sample was confined to one state, Florida, and ours was a national sample.

With regard to the first research hypothesis concerning liquidity, as the net days revenue in accounts receivable increased in the second quartile, hospitals were significantly less likely to adopt EHR. This is an expected finding in that hospitals with less efficient collections would be less liquid and therefore in a poorer position to adopt EHR. Further, this relationship is only apparent after breaking the variable into quartiles to account for the occasional nonlinearity of financial variables (Chan, Feldman, and Manning 1999). Our findings are in contrast to Wang and colleagues (2005), who found that IT adoption strategies

are not very responsive to another measure of liquidity, days cash on hand. Once again, their dataset was from a much earlier time, 1998.

With regard to the fourth research hypothesis concerning efficient utilization of assets, as the asset turnover ratios increased, the likelihood of adoption steadily and significantly decreased. This means that as the revenue generation for each dollar of total assets increased, the likelihood of adoption steadily decreased. When one considers that it was mostly very large hospitals that adopted EHR (McCullough et al. 2010) it is not surprising that asset turnover was negatively associated with EHR adoption. Also, efficient utilization of assets would to some degree be a function of the competitive strategy of a hospital, and competitive strategy has been shown to be associated with size. Using the Miles and Snow (1978) typology of organizational strategy, Ginn (1990) found that hospitals exhibiting a Defender strategy, which compete based on efficiency, tend to be very small hospitals. Further, Ginn found that Analyzers, hospitals that compete based on both effectiveness and efficiency, tend to be very large hospitals. Thus, large hospitals that compete based on effectiveness and efficiency might well be expected to have lower asset turnover ratios than small hospitals.

Consistent with Wang and colleagues (2005) we included network participation as a control variable. However, neither their study nor ours shows network participation to be a significant control variable with regard to EHR adoption.

Other control variables in our study were significant. For example, FTE nurses per adjusted average daily census was a significant factor associated with EHR adoption. Further, the higher the quartile, the higher was the likelihood of adoption. Similarly, as average daily census per staffed bed increased, the likelihood of adoption of EHR increased significantly.

Bed size was a highly significant control variable in our study, as it was in the study by Kazley and Ozcan (2007). As bed size increased, hospitals were significantly more likely to adopt EHR. This comes as no surprise since we already know that academic medical centers have found EHR to be especially useful in dealing with complexity. It seems reasonable to assume that larger academic medical centers would be faced with more complexity and therefore exhibit a greater proclivity for adoption of EHR (McCullough et al. 2010).

Obviously there are limitations to what can be inferred from this study. First, because some hospitals were left out of the study due to missing provider numbers, extreme outliers, or questionable financial data, there is always the possibility of selection bias. Second, because there are practical limitations to the variables that are available for inclusion in the study, the exclusions of critical explanatory variables, such as variables to measure the organizational strategy of hospitals or the institutional pressure of the local environment, may lead us to make different conclusions. Third, one can always question the value of a dependent variable such as EHR adoption that has not been validated. Fourth, the cross-sectional nature

of the study limits the causal inferences that can be made.

CONCLUSIONS

Managers may conclude that EHR adoption is not so much a financial decision as a strategic decision. Apparently hospitals adopt EHR to better align themselves with their environment. On the one hand, smaller hospitals whose patients have a lower acuity case mix simply may not benefit clinically, operationally, or financially from adopting EHR. For the smaller hospitals, a capital outlay to adopt EHR may actually degrade financial outcomes. Financial performance would reflect lower asset turnover ratios, as assets would have been added to the denominator without any concomitant addition of revenue to the numerator. On the other hand, larger hospitals, especially academic medical centers with a high acuity case mix, may benefit from investing in EHR adoption. For larger hospitals with large numbers of patients with complex medical problems, significantly better clinical outcomes may accrue from the adoption of EHR (McCullough et al. 2010). Thus, even though hospitals may frequently mention financial position as the major barrier to adoption of EHR (Jha et al. 2009), the overall lack of association between financial ratios and EHR adoption in our study suggest that the size of the hospital and its environmental context are also significant issues.

Healthcare policymakers will find little in the results of our study to counter the concerns raised by McCullough and colleagues (2010). They concluded that EHR adoption was clearly beneficial for large hospitals such as academic medical centers, but not for small hospitals. We think that in addition to financial incentives, healthcare policymakers should consider the strategic interests of individual hospitals. The Miles and Snow (1978) typology implicitly assumes the effects of resource dependence (Pfeffer and Salancik 1978). Thus, hospitals facing the same environmental threat will not respond in a monolithic way. Because of differences in size, structure, and local environment, each hospital will exercise strategic choice in responding to institutional pressure. Thus, each hospital will make a strategic decision that it perceives will improve its fit with the environment. Healthcare policymakers should therefore consider the possible merits of a policy that promotes something less than universal EHR adoption.

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PRACTITIONER APPLICATION

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While the first electronic health record (EHR) appeared more than thirty years ago, the technology in general has matured slowly. Those early systems, used by organizations such as Harvard, LDS Hospital, Duke, Emory, and the VA, were the forerunners of our current universe of EHRs. While many years have passed, the systems have not strayed far from their roots. Improvement has been slow, and this immaturity, along with the up-front and ongoing costs, guaranteed for most of those years that only early adopters (mostly academic medical centers) made significant gains in value.

My first exposure to EHRs was in the early 1990s at Children's Medical Center in Dallas. Even at that early stage, we struggled with the discontinuity between information in various places throughout the medical center. Working to connect systems for accurate and timely workflow was a huge challenge. As I have overseen deployment of different EHRs from different vendors, my conclusions have remained consistent: It is not about the technology. While there are certainly some products out there that should never be used, most are capable of basic functionality—and many are capable of advanced clinical information handling.

From this article's title through the statistical exhibits to the conclusion, I read with expectation, anticipation, and some degree of dread seeking the results that emerged. At times, I felt the temptation—as with that last good book I read—to flip to the end (the conclusions) and hear the bottom line.

But as in the actual implementation of EHRs, trying to skip to the end can be risky business. I appreciated the duly scientific approach of going to the literature for historical perspective on the adoption of EHRs, but I believe the difficulty is the lack of current data that allow for comparison of dissimilar organizational experiences. The data set for this study, while the best available, represents information from 2006 and 2007.

With the passage of the American Recovery and Reinvestment Act of 2009, the EHR forecast has changed dramatically. Also, the measurement of EHR adoption is a challenge for this study (a three-value ordinal variable adopted from a 2009 study), just as it is a challenge in practice. Deployment of EHRs is most often done in a phased approach with different acute care specialties adopting at different rates. Any classification of adoption that relies on complete and common use ("all major clinical areas" in this study) across specialties will be difficult to advance.

Studies have long disagreed on the ability of EHRs to improve quality and financial outcomes. Most practitioners realized that the successes and failures in

the field link not to the simple presence of the technology but to the quality of the implementation and integration of the technology with the complex workflow and information exchange in the healthcare environment. Success with EHRs is about a short list of critical items: (1) a reliable EHR vendor who will support you for the long haul; (2) buy-in and ownership from clinicians at all stages of the EHR lifecycle; and (3) an ongoing commitment to improvement of the EHR content and workflow, particularly integration of evidence-based medicine protocols and lexicons. Beyond those three critical items, you, of course, want an affordable solution and one that is relatively user friendly; but you can have a friendly and free system that can still completely fail.

As the authors conclude, "each hospital will make a strategic decision" in regard to EHRs. The practical reality is that hospitals now believe in the inevitability of EHR deployment across the continuum of care—and hospitals that intend to continue as a viable part of this country's healthcare system are planning on their future in an EHR-oriented reality.