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Hospital Characteristics are Associated With Readiness to Attain Stage 2 Meaningful Use of Electronic Health Records

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Abstract

Purpose: To examine the difference between rural and urban hospitals as to their overall level of readiness for stage 2 meaningful use of electronic health records (EHRs) and to identify other key factors that affect their readiness for stage 2 meaningful use.

Methods: A conceptual framework based on the theory of organizational readiness for change was used in a cross-sectional multivariate analysis using 2,083 samples drawn from the HIMSS Analytics survey conducted with US hospitals in 2013.

Findings: Rural hospitals were less likely to be ready for stage 2 meaningful use compared to urban hospitals in the United States (OR = 0.49) in our final model. Hospitals' past experience with an information exchange initiative, staff size in the information system department, and the Chief Information Officer (CIO)'s responsibility for health information management were identified as the most critical organizational contextual factors that were associated with hospitals' readiness for stage 2. Rural hospitals lag behind urban hospitals in EHR adoption, which will hinder the interoperability of EHRs among providers across the nation. The identification of critical factors that relate to the adoption of EHR systems provides insights into possible organizational change efforts that can help hospitals to succeed in attaining meaningful use requirements.

Conclusion: Rural hospitals have increasingly limited resources, which have resulted in a struggle for these facilities to attain meaningful use. Given increasing closures among rural hospitals, it is all the more important that EHR development focus on advancing rural hospital quality of care and linkages with patients and other organizations supporting the care of their patients.

Key words health services research, hospitals, management, organization theory, technology.

It is widely believed that adopting electronic health record (EHR) systems will significantly improve the efficiency of health care systems and enhance the quality of care provided to patients.^{1,2} For this reason, the United States has developed and funded major initiatives for the implementation of EHR systems. Specifically, the Health Information Technology for Economic and Clinical Health (HITECH) Act, passed as part of the American Recovery and Reinvestment Act of 2009 (ARRA), established a framework for incentive payments for meaningful use of EHRs and since 2009 has encouraged many health care providers to adopt EHR systems.^{3,4}

Meaningful use is defined as providers' "use of EHRs in ways that positively affect patient care."⁵ To receive incentive payments for meaningful use of EHRs, as defined by the Centers for Medicare and Medicaid Services (CMS), eligible health care organizations need to meet requirements pertaining to 3 stages of EHR adoption. According to the CMS, EHR adoption of meaningful use should be met sequentially over 5 years. For stage 1, the requirements are focused on data capture and sharing. The focus shifts to advanced clinical processes for stage 2, and to improved outcomes for stage 3. Hospitals can qualify for an incentive payment for stage 1 by attesting to having met stage 1 requirements based on

attaining at least 18 of 23 meaningful use objectives. Hospitals must meet stage 2 objectives in addition to stage 1 objectives in order to receive an incentive payment for stage 2.⁴

Success in fulfilling requirements for meaningful use will be the critical criterion in health care reform's drive for improved quality and efficiency in the health care system.⁶ Attaining meaningful use of EHR systems will help health care providers avoid prescription errors and improve the quality of medical record-keeping.^{5,6} As well, it will enhance access to medical records for both providers and patients. Meaningful use will facilitate these improvements by ensuring that providers and other allied health professionals have better access to accurate clinical information not only within their individual hospital system, but across multiple hospital systems that communicate with each other by exchanging clinical data.

Even though a growing number of hospitals have implemented EHR systems in recent years, studies have shown that many hospitals have struggled to do so because of practical barriers.⁶⁻⁸ Overall, the rate of EHR adoption has been slower than expected. Some studies reported that hospitals in small towns and rural areas have especially lagged behind in EHR adoption.⁹⁻¹² As a result, concerns have emerged about the future of rural hospitals—the fear that slow adoption may leave rural areas disadvantaged in terms of both the quality and the efficiency of health care delivery. A lower level of EHR adoption in some areas may also hinder the interoperability of EHRs across the nation.¹³ However, several national studies using different data reported conflicting results about the rate and level of EHR adoption. Some studies have found no difference in the level of EHR adoption between rural and urban hospitals.¹⁴⁻¹⁶

Given the currently available conflicting results about the level of EHR adoption in different locations, it seems advisable—before debating next steps—to first take a closer look at the present status of EHR adoption across rural and urban hospitals in the United States. The purpose of this study is to ascertain whether any meaningful differences in EHR adoption exist between rural and urban hospitals in the United States.

EHR adoption should be viewed as a major dynamic organizational learning process.¹⁷ There have been many studies about the critical factors for successful EHR implementation and adoption by health care organizations. Current known facilitators of implementation are communication with end-users, leadership involvement, and training.¹⁸ Current known barriers are lack of organizational support, such as financial and staff resources, and end-users' resistance to change.^{7,19} However, these factors affect hospitals differently depending on the details of their organizational contexts. According to Weiner, organizational contextual factors invariably affect the effectiveness of organizational change.²⁰ In other words, commonly known success factors identified in the literature may work differently in different contexts. Hospital locations (rural or urban) and other organizational contextual factors such as organizational culture, policies and procedures, past experience, organizational resources, and organizational structure are all possible factors that impact the effectiveness of EHR adoption.²⁰ This study aimed to examine the difference between rural and urban hospitals with regard to their overall level of organizational readiness for stage 2 meaningful use of EHRs and to identify other key factors that affect hospitals' level of organizational readiness for attaining stage 2. Using the model proposed in this paper (Figure 1), we tested our hypotheses (1) that rural hospitals are less likely than urban hospitals to be ready for stage 2 meaningful use of EHRs; and that particular identifiable contextual factors differently affect these hospitals' level of organizational readiness for attaining stage 2 meaningful use of EHRs

Methods

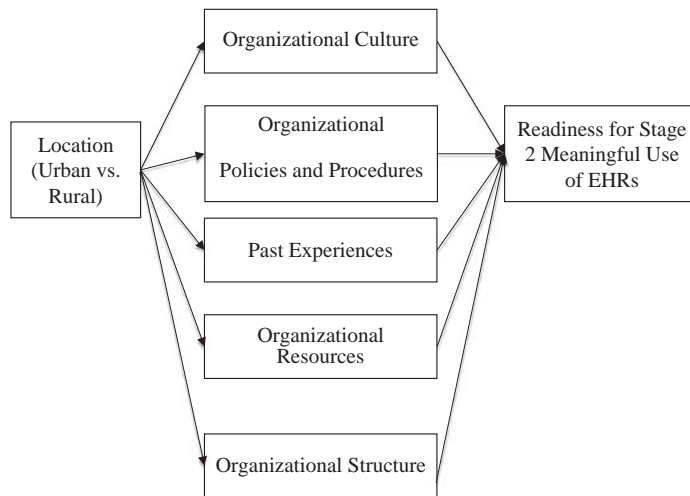
Theoretical Framework

Figure 1 illustrates the theoretical framework used in this study. It explains that hospital location affects the organizational contextual factors and these different organizational contextual factors affect the readiness for stage 2 meaningful use of EHRs.

Data

The data used in this study were collected on 5,467 hospitals in the United States from the HIMSS Analytics (Chicago, Illinois) annual survey of 2013. The survey provided data on a variety of organizational characteristics as well as information pertaining to health information technology including the current status of EHR adoption. Access to the HIMSS Analytics data was obtained from HIMSS Analytics by the Texas A&M Health Science Center School of Public Health. The study was reviewed and approved by the Texas A&M University Institutional Review Board.

Figure 1 Theoretical Framework



Sample

The sample for this study included 2,083 hospitals in the United States that participated in the HIMSS Analytics annual survey of 2013 and answered the survey's questions regarding the attestation to CMS of meaningful use of EHRs. Of the 5,467 hospitals surveyed, 2,083 responded to the question asking about the attestation of meaningful use. As the answer to the question regarding attestation was our dependent variable, we built our model and analyzed the data based on the corresponding 2,083 samples. However, we also conducted a sensitivity test by treating the missing answers as negative responses for attaining stage 1 meaningful use in order to minimize the effect of the missing data.

Model Building

The stage 2 benchmark of meaningful use became effective in 2014. Hospitals must meet stage 1 meaningful use criteria for 2 or 3 years to become eligible to receive the incentive payment for stage 2 meaningful use. The attestation regarding attainment of stage 1 meaningful use is the starting point of hospitals' readiness for stage 2. We determined that hospitals were ready for stage 2 meaningful use when they had attained stage 1 meaningful use. Thus, the dependent variable in this study was a dichotomous variable indicating that attestation for having met stage 1 meaningful use requirements has been provided, or not. The primary independent variable in this study was hospital location (rural or urban). According to the United States Census Bureau, Core Based Statistical Areas (CBSAs) refer to both metropolitan and micropolitan statistical areas.²¹ Hospital location was coded to "rural area" if the data field in the CBSAs database for information about hospital location was left blank. Otherwise, hospital location was coded to "urban area." Other covariates were categorized into 5 contextual factor constructs suggested by Weiner.²⁰ These other covariates were (1) the mandate of physicians' utilization of a computerized physician order entry (CPOE) system for the construct of organizational culture; (2)

organizational type (government, for profit, or not-for-profit) for the construct of organizational policies and procedures; participation in an information exchange (IE) initiative for the construct of past experience; (4) the ratio of information system (IS) full-time equivalents (FTEs) to total FTEs, IS FTEs that support EHR applications, IS FTEs at the helpdesk, and IS FTEs in management for the construct of organizational resources; and (5) the existence of a Chief Information Officer (CIO) position with responsibility for health information management for the construct of organizational structure.

Analysis

Descriptive statistics were used to examine differences in the current level of hospitals' readiness for stage 2 meaningful use with reference to US states, US census regions (Northeast, Midwest, South, or West), organization type (government, for-profit, or nonprofit), and ownership status (leased, owned, or managed).

Before conducting a multivariable logistic regression analysis, bivariate logistic regression analysis was first used to discern a possible relationship between hospitals' readiness for stage 2 by location. Bivariate analysis was also performed to investigate the potential relationship between hospitals' readiness for stage 2 and each organizational contextual factor.

Because of the high degree of multicollinearity among variables and different patterns of responses and missing responses, 5 different regression models were built instead of a single model with all variables. These 5 models used the primary independent variable (hospital location) and different covariates from the 5 constructs derived from organizational contextual factors (organizational culture, organizational policies and procedures, past experience, organizational resources, and organizational structure). This approach was taken in order to test a nonnested alternative hypothesis in each of the 5 models and to select significant covariates based on the resulting P values.²² Multivariable logistic regression analysis was conducted with the final model including the main independent variable (hospital location) and significant covariates selected from the 5 aforementioned models to estimate the odds ratio (with a 95% confidence interval) for the independent effect of location and organizational contextual factors on hospitals' readiness for stage 2 meaningful use of EHRs.

Access to the HIMSS Analytics data was obtained from HIMSS Analytics by the Texas A&M Health Science Center School of Public Health. The study was reviewed and approved by the Texas A&M University Institutional Review Board.

Results

Descriptive Statistics

As shown in Figure 2, hospitals in different states reported different levels of readiness for stage 2 meaningful use of EHRs. Specifically, the sample proportion of hospitals reporting the attainment of stage 1 meaningful use in the Northeast (92%) and in the South (87%) was greater than that for hospitals in the West (79%) or in the Midwest (86%) as shown in Table 1. Overall, the sample proportion of hospitals reporting the attainment of stage 1 meaningful use was 86%, which was about the same as that in the Midwest (86%) and slightly lower than that in the South (87%; Table 1). The sample proportion of rural hospitals reporting the attainment of stage 1 meaningful use was 79%, which was lower than that of urban hospitals (88%; Table 1).

The level of readiness for stage 2 also varied with reference to the type of organization and ownership. Government hospitals were less likely to be ready for stage 2 than were for-profit and not-for-profit hospitals (Table 1). The majority of hospitals in our sample were operated by their owners. However, the results showed that leased hospitals might have been more likely to be ready for stage 2 than managed or owned hospitals, although the observed difference was not statistically significant (Table 1)

Regression Results

We analyzed the effects of each of 5 constructs on hospitals' readiness for stage 2 meaningful use after adjusting for hospital location as summarized in Table 2. As to organizational culture, there was no statistically significant difference in readiness for stage 2 whether hospitals mandated CPOE or not (OR = 1.26, $P = .212$). Table 2 also shows the effects of organizational policies and procedures on hospitals' readiness for stage 2 meaningful use. Both for-profit hospitals (OR = 1.68, $P = .024$) and not-for-profit hospitals (OR = 1.54, $P = .0003$) were more likely to be ready for stage 2 meaningful use than government hospitals. Hospitals that had experienced IE in the past showed a higher level of readiness for stage 2 meaningful use (OR = 1.73, $P < .001$) compared to those who did not have any past experience. As to the effect of organizational resources on the readiness for stage 2 meaningful use, hospitals with more human resources related to IS management and EHR support were more likely to be ready for stage 2 meaningful use. Different organizational structure also affected hospitals' readiness for stage 2. Those hospitals that had a CIO in charge of health information management showed a higher level of readiness for stage 2 (OR = 1.52, $P = .023$; Table 2).

Hospitals' past experience with IE initiatives (OR = 1.63, $P < .001$), the existence of FTEs supporting EHR applications (OR = 1.55, $P = .054$), the ratio of IS FTEs to total FTEs (OR = 1.008, $P = .003$), and having a CIO responsible for health information management (OR = 1.48, $P = .041$) were identified as the most critical organizational contextual factors that affect hospitals' readiness for stage 2 meaningful use of EHRs after adjusting for hospital location (Table 2). The result of the final model including these statistically significant variables and hospital location is summarized in Table 3. Rural hospitals were generally less likely to be ready for stage 2 when compared to urban hospitals (OR = 0.49, $P = .003$) after adjusting for other critical factors including hospitals' past experience with IE initiatives, human resources in IS departments, human resources in EHR support, and CIOs responsible for health information management.

Discussion

The results of this study indicate a strong link between hospital location and readiness for stage 2 meaningful use of EHRs by supporting our hypothesis that rural hospitals are less likely than urban hospitals to be ready for stage 2 meaningful use, suggesting that many rural hospitals still lag behind in EHR adoption and still face the challenge of meeting stage 1 meaningful use requirements. Meanwhile, stage 2 meaningful use requirements have been in effect since January 2014. Because hospitals must meet stage 1 meaningful use requirements in order to qualify for stage 2 meaningful use incentive payments, but many rural hospitals are still struggling to meet stage 1 requirements, the incentive payments already in place for

Table 1 Descriptive Statistics

		N	Ready for Stage 2 Meaningful Use (%)	Not Ready for Stage 2 Meaningful Use (%)	P-Value
Location	Total	2,083	86	14	$P < .001$
	Rural	395	79	21	
	Urban	1,688	88	12	
Region	Total	2,083	86	14	$P < .001$
	Northeast	296	92	8	
	Midwest	644	86	14	
	South	787	87	13	
	West	356	79	21	
Organization type	Total	2,055	86	14	$P < .007$
	Government	429	81	19	
	For-profit	250	88	12	
	Not-For-Profit	1376	87	13	
Ownership status	Total	2,083	86	14	$P < .404$
	Leased	31	90	10	
	Managed	69	81	19	
	Owned	1983	86	14	

Table 2 Estimates of Effect of Hospital Location and Other Factors on the Readiness for Stage 2 Meaningful Use of EHRs

Variable	Model Predicting Readiness for Stage 2 Meaningful Use							
	Not Adjusted				Adjusted Estimate			
	N	Odds Ratio	(95% CI)	P value	N	Odds Ratio	(95% CI)	P-value
Rural	2083	0.55	(0.41–0.73)	< .001	1414	0.61	(0.41–0.93)	.020
CPOE mandated ^a	1414	1.26	(0.88–1.80)	.212	1414	1.17	(0.82–1.69)	.386
Rural	2083	0.55	(0.41–0.73)	< .001	2055	0.59	(0.43–0.79)	.001
Organization Type	2055				2055			
Government		base	–	–		base	–	–
For Profit		1.68	(1.07–2.64)	.024		1.37	(0.86–2.19)	.191
Not for Profit		1.54	(1.15–2.06)	.003		1.30	(0.96–1.77)	.092
Rural	2083	0.55	(0.41–0.73)	< .001	1806	0.59	(0.44–0.79)	< .001
IE initiative ^b	1806	1.73	(1.34–2.24)	< .001	1806	1.63	(1.25–2.12)	< .001
Rural	2083	0.55	(0.41–0.73)	< .001	795	0.65	(0.42–1.01)	.055
Ratio of IS FTEs to total FTEs	973	1.004	(1.0003–1.0070)	.011	795	1.008	(1.002–1.013)	.003
IS FTEs supporting EHR applications ^c	833	1.51	(1.06–2.17)	.024	795	1.55	(0.99–2.41)	.054
IS FTEs at Helpdesk	831	1.47	(1.02–2.10)	.037	795	1.48	(0.95–2.29)	.080
IS FTEs in management	838	2.19	(1.20–3.98)	.015	795	1.71	(0.68–4.28)	.254
Rural	2083	0.55	(0.41–0.73)	< .001	1305	0.50	(0.36–0.70)	< .001
CIO HIM ^d	1305	1.52	(1.05–2.20)	.023	1305	1.48	(1.02–2.15)	.041

^aDid the health care system mandate that physicians utilize a CPOE system?

^bDoes the hospital participate in an Information Exchange Initiatives?

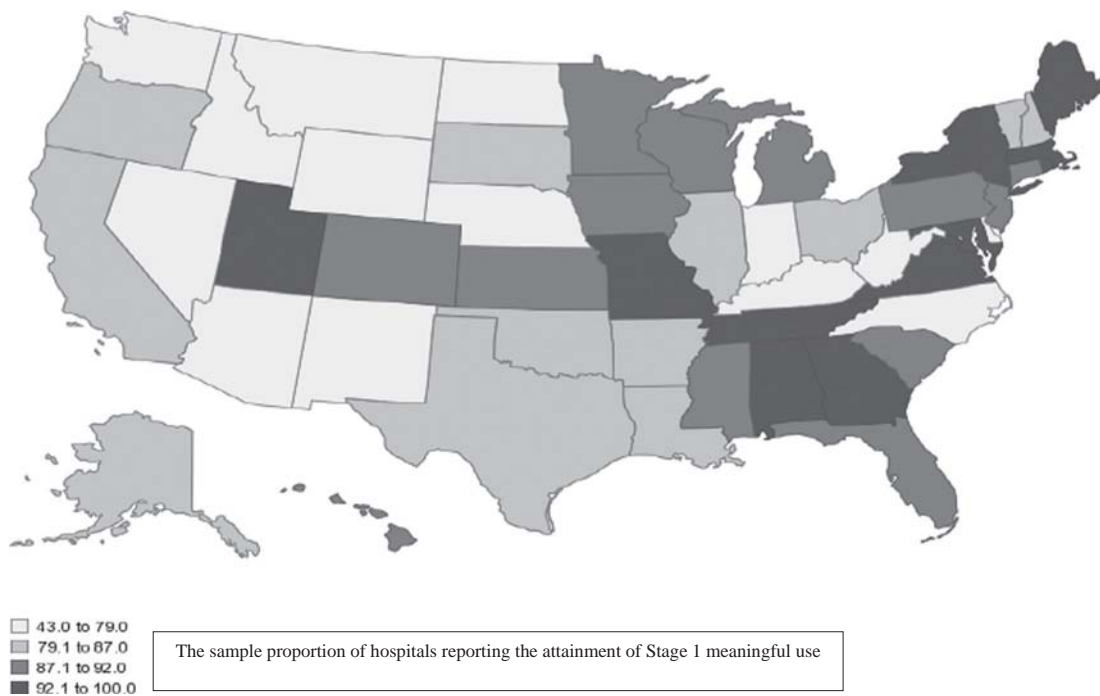
^cDoes the hospital have Information System (IS) FTEs that support EHR applications?

^dDoes the hospital Chief Information Officer (CIO) have responsibility for Health Information Management (HIM)?

stage 2 are eluding these facilities. This lower level of readiness for stage 2 among rural hospitals will not only leave rural areas disadvantaged in terms of the quality and efficiency of available health care but will also hinder the interoperability of EHRs among providers across the nation. To achieve the national goal, an overall improvement of quality and efficiency in health care, we need to remove this substantial difference in the pace of EHR adoption between rural and urban hospitals.

This study's findings also supported our hypothesis that a number of particular, identifiable contextual factors affect these hospitals' level of organizational readiness for attaining stage 2 meaningful use of EHRs. This suggests that rural hospitals may partially offset the disadvantages of rural status on their level of readiness for stage 2 meaningful use of EHRs by expanding other factors associated with increased readiness, such as allocating additional resources to their IS departments, and by installing a CIO with responsibility for taking charge of their health information systems. Our results did not indicate that IS support for the EHR applications was a statistically significant factor in this problem, even when the variable with a count of IS FTEs that support EMR applications was recoded to assume hospitals with missing values had no IS support (0 FTE). The identification of critical factors that were associated with the adoption of EHR provides insights into possible organizational change efforts that were likely to help rural hospitals succeed in meeting meaningful use requirements and thereby attaining the desired improvement of quality and efficiency in health care delivery.²⁰

Figure 2 States' Readiness for Stage 2 Meaningful Use of EHRs 2013



Many rural providers use up their resources when they purchase expensive EHR systems and fail to use their incentive payments to educate their staff and patients and customize their new EHR systems.²³ A recent study found that rural and small hospitals showed more homogeneous and standardized EHR adoption patterns than urban hospitals.²⁴ This scenario is likely to result in greater challenges—and delays—in meeting stage 2 requirements, which are more focused on the active exchange of health information internally and externally among providers and patients. Because of the high initial cost of implementing EHR systems, it is likely to be very difficult if not impossible for many rural hospitals to meet requirements for stage 2 meaningful use. Start-up funds are necessary for rural hospitals to invest in EHRs. Loan programs for rural and small hospitals may be necessary to help them meet stage 2 requirements.

Our results suggest that rural hospitals might need to invest proportionately more resources in IS to overcome the barriers to meaningful use inherently associated with rural location such as a lack of information technology (IT) infrastructure and qualified IT professionals. The current lack of digital infrastructure in many rural areas will of course further burden rural providers as they strive to attain stage 2. Because of the lower level of broadband communications infrastructure and internet connectivity coverage in rural areas as compared to urban areas, it is predictable that rural hospitals will continue to struggle to become hubs of efficient health communication.²⁵ Rural hospitals also face difficulties in staffing in all areas, not least in their IT departments. High turnover of staff and the lack of new and sustainable staff are a perennial challenge.²⁶⁻²⁸ The reality is that staff in rural hospitals already tend to assume multiple tasks and are not readily able to assume additional IT tasks which often require much more effort and time.¹⁶ Consequently, experienced IT specialists are in high demand, and it is challenging for providers in rural areas to find enough local IT professionals to help them meet meaningful use criteria.

Another challenge facing rural hospitals in attaining meaningful use is the characteristics of the rural populations they serve. Rural residents tend to be older and less likely to have internet access, and those who do have internet access and good computer literacy may disproportionately commute to urban areas for both their work and health care services. This will make it even harder for rural hospitals to engage patients in communicating through EHR systems, one of the important goals of stage 2 meaningful use. Educating patients may in time increase the level of EHR use in the way that CMS suggests. However, education efforts involve costs as well, which will be a further burden on rural hospitals.

Table 3 Estimates of Effect of Hospital Location and Other Critical Factors on the Readiness for Stage 2 Meaningful Use of EHRs

Variable	Model Predicting Readiness for Stage 2							
	Not Adjusted				Adjusted Estimate			
	N	Odds Ratio	(95% CI)	P value	N	Odds Ratio	(95% CI)	P value
Rural	2083	0.55	(0.41–0.72)	< .001	625	0.49	(0.30–0.89)	.003
IE Initiative	1806	1.73	(1.34–2.24)	< .001	625	1.89	(1.23–2.92)	.004
Ratio of IS FTEs to total FTEs	973	1.004	(1.0003–1.0070)	.031	625	1.006	(1.0007–1.0116)	.027
FTEs supporting EHR applications ^a	833	1.51	(1.06–2.17)	.024	625	1.46	(0.89–2.38)	.135
CIO HIM ^b	1305	1.52	(1.05–2.20)	.028	625	1.75	(0.96–3.16)	.066

^aDoes the hospital have Information System (IS) FTEs that support EHR applications?

^bDoes the hospital Chief Information Officer (CIO) have responsibility for Health Information Management (HIM)?

Finally, rural patients are more likely than urban patients to have Medicare as their principal source of payment.²⁹ From 2015 CMS started imposing a penalty on providers who participate in Medicare but are not able to meet meaningful use requirements by 2015.³⁰ A reduction in Medicare payments will further aggravate the financial predicament of rural hospitals and will likely make it even more challenging for them to attain stage 2. This study has several limitations. First, the design of this study is cross-sectional. Even though we identified the relationship between hospitals' readiness for stage 2 meaningful use and other critical contextual factors, this result may not provide cause-and-effect relationship. In addition, the sample size of our study was small. The response rate for the question regarding the attestation for having met stage 1 meaningful use was 38%. Although we tried to minimize the proportion of missing data caused by different patterns of item nonresponses across respondents—by building up the final model only with statistically significant variables after estimating 5 different models according to 5 different constructs related to organizational readiness for change—the sample size in our final model for analysis was relatively small. This may lead to potential bias in determining the relationship between hospitals' readiness for stage 2 meaningful use and critical factors identified in this study. We also conducted a sensitivity test to examine the effect of the missing data. Even when the dependent variable of meaningful use attainment was recoded as negative attestation, our results from the final model still indicated that rural hospitals were less likely to be ready for stage 2 meaningful use after adjusting for other factors (OR = 0.59, P = .001).

This study is based on the analysis of self-report surveys. We assumed that hospitals were able to provide correct answers to the questions regarding their location and attainment of meaningful use. However, there is also a possibility that some hospitals were not able to provide correct answers to these questions or simply chose not to respond due to the lack of knowledge. For example, our coding of blank CBSAs as rural areas may affect the results regarding rural hospitals' readiness for stage 2 meaningful use.

Conclusion

Rural hospitals have struggled more than their urban counterparts to attain meaningful use criteria, and they may eventually face penalties for not having attained meaningful use criteria. Regardless of other change-related efforts identified in this study that hospitals may input to increase the level of readiness for stage 2 meaningful use, rural hospitals are more likely to be left behind due to their limited resources.

To help rural hospitals increase their level of readiness for stage 2 meaningful use and receive the incentive payments they badly need, modified and differentiated time schedules could be developed and proposed to rural hospitals. For those who have not yet attained stage 1 meaningful use, it may be time to consider the adoption of a different, more realistic timeline for attaining stage 2.

In light of evidence of recent increases in the number of closures among rural hospitals, it is

increasingly important that EHR strategies contribute to the ability of rural hospitals to attract patients now and again in the future.^{31,32} Increased attention might well be given to how an EHR can contribute to the quality of patient care during and after a rural hospital visit and how it can link the hospital to physicians, labs, pharmacies, and referral hospitals.

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