

# The Impact of Geography on Hospital Electronic Health Records Implementation in Alabama

## Implications for Meaningful Use

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### Keywords

Electronic health records, healthcare disparities, rural health, meaningful use, hospital information system

### Summary

**Background:** Given relatively less favorable health outcomes in rural Alabama, electronic health records (EHRs) have an even greater potential to improve quality and alleviate disparities if meaningfully used.

**Objectives:** We examined rural-urban differences as it pertained to perceived barriers, benefits, and motivating factors of EHR implementation.

**Methods:** We used multivariate logistic models to analyze data collected from a state-wide, self-completed survey of health information management directors in Alabama hospitals.

**Results:** Findings from our analyses indicate that fewer rural hospitals (8%) have implemented EHRs as compared with urban hospitals (18%). Rural hospitals were 71% less likely to consider reduction in costs as a benefit of EHRs (OR = 0.29), and were 75% less likely to consider lack of structured technology as a challenge factor of EHR implementation (OR = 0.25).

**Conclusion:** Promotion of EHRs in rural areas is challenging but necessary. Understanding perceived barriers and motivating factors of EHR implementation among rural hospitals can inform policy decisions, especially in light of recent meaningful use initiatives.

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## 1. Introduction

Electronic Health Records (EHRs), defined by the Healthcare Information and Management Systems Society as “a longitudinal electronic record of patient health information generated by one or more encounters in any care delivery setting” [1], has been heralded to deliver benefits in the hospital setting [2, 3]. These specific benefits include improved work flow [4], safer patient handoffs [4], epidemiological monitoring and evaluation [5], adherence to care protocols [3], and a reduction in medication errors [3]. Although national EHR implementation is increasing [2, 6], there appears to be a “digital divide” between hospitals predominantly in rural America and their urban counterparts [7, 8].

The literature on barriers to and benefits of EHR implementation has paid close attention to ambulatory physicians [9–11]. Studies on health information technology in rural locations have either documented the resource-deficient conditions [12], focused on ambulatory physicians [13], or have examined umbrella technologies such as Patient Safety-Related Information Technologies [14]. While reasons for the chasm in EHR implementation in the hospital setting have been qualitatively documented [15], to our knowledge, no study has empirically examined the relationship between geographic location within a largely rural state such as Alabama – the Alabama Rural Health Association classifies 55 of 67 of Alabama’s counties as rural [16], and motivating factors, expected benefits, and perceived barriers to EHR implementation. Alabama leads the nation in terms of proportion of the state’s population in rural areas [17]. The mean per-capita income in Alabama in 2008 was \$35,506, but was \$29,036 in rural parts of the state. Compared with a 16.2% poverty rate in urban areas, the poverty rate in rural Alabama was 21.0% in 2008. About 14% of Alabama’s residents do not have health insurance [18].

The divide between rural and urban EHR implementation rates may be exacerbated by recent congressional initiatives designed to incentivize the widespread implementation of EHR and other health information technologies. Specifically, the American Recovery and Reinvestment Act of 2009 (ARRA), provides financial incentives to hospitals who can document that they are a “meaningful user of certified EHR technology [19]. According to the Centers for Medicare and Medicaid Services (CMS), meaningful use is a “core” set of required objectives and “menu set” of criteria from which providers can choose to demonstrate they are utilizing an approved EHR system [certified by the Office of the National Coordinator for Health Information Technology (ONC)] in a manner that meets the “initial standards, implementation specifications, and certification criteria [19]. Specifically, a meaningful user of EHR is one that meets the following requirements:

1. demonstrates use of certified EHR technology in a meaningful manner;
2. demonstrates to the satisfaction of the Secretary that certified EHR technology is connected in a manner that provides for the electronic exchange of health information to improve the quality of health care such as promoting care coordination, in accordance with all laws and standards applicable to the exchange of information; and
3. using its certified EHR technology, submits to the Secretary, in a form and manner specified by the Secretary, information on clinical quality measures and other measures specified by the Secretary [20].

Despite the availability of incentive payments that target rural health stakeholders [21, 22], the issue of some rural providers being unable to achieve the relatively high standards set for EHR implementation is predicted to widen the “digital divide”.

To bridge the aforementioned gap in the literature, this study examines how rural or urban geographic location predicts the likelihood of certain motivating factors, expected benefits, and perceived barriers surrounding hospital-wide EHR implementation. We utilized data from a state-wide survey of Alabama hospitals on EHR implementation issues, and based on findings from our study, we highlight issues relevant to the current debate on meaningful use.

## 2. Background

After about a year of invited public commentary, rigorous debate, and continual modification based on input from relevant stakeholders, CMS released the final rule on meaningful use on July 13, 2010 [23–27]. The concerted federal leadership was a result of the realization, about a decade ago, via the Institute of Medicine reports — *To Err is Human* [28] and *Crossing the Quality Chasm* [29] — that the United States health care system was in need of automation of healthcare processes and digitization of health records and information systems.

The passage of the Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009 made possible the award of incentives to providers who demonstrate “meaningful use” of EHR systems. Since the adoption of EHR systems by just a certain number of providers would impede the achievement of system-wide benefits of EHR adoption and the overall goal of better delivery of care, Congress found a need to promote the adoption and meaningful use of EHRs. Not only will providers be able to exchange patient information thereby reducing the need for tests to be repeated, cost-effectiveness should be realized from the streamlining of healthcare processes. To bring the United States up to par with other developed countries that have successfully adopted EHRs [6], the Department of Health and Human Services hoped that the meaningful use objectives, standards, implementation guidelines, and certification criteria announced in the summer of 2010 would significantly hasten the adoption of EHRs via targeted incentives that would total \$27 billion distributed to Medicare and Medicaid providers over a ten year timeframe.

In general terms, in order to qualify for incentive payments, providers must “use a certified EHR in a meaningful manner (to electronically store and retrieve patient chart information, or electronically prescribe), must use a certified EHR technology to electronically exchange health information to improve quality of healthcare, and must use a certified EHR system to submit clinical quality and other measures” [30]. In specific terms, both urban and rural hospitals must demonstrate the achievement of 14 core objectives and 5 of 10 menu set objectives [30].

However, the American Hospital Association and other relevant stakeholders have brought attention to the possibility that the meaningful use criteria may be too difficult for rural hospitals to achieve, despite the fact that hospitals can implement EHRs in smaller increments by working towards qualifying for Medicaid EHR incentive payments for implementing or upgrading certified EHR systems during their first year of implementation [7, 31]. Factors such as having the financial and human resources required for EHR implementation, which are persistent rural challenges, complicate and challenge the adoption of EHR in rural hospitals. HITECH incentives may not fully address the resource constraints of rural hospitals given that the financial incentives are not expected to cover the full cost of EHR implementation and given the staggered disbursement of incentive payments [30].

## 3. Methods

### 3.1 Sampling Procedure and Survey Administration

Using hospital names and addresses of all hospitals in the 2006 Alabama Hospital Association directory, and names of the Health Information Management (HIM) directors at each of the hospitals from the Alabama Association of Health Information Management, we mailed our survey to all 131 Alabama hospitals indexed in both databases. A month after the surveys were first mailed, a follow-up letter and email was sent to HIM directors who had not responded. Our final sample consists of 91 valid surveys, which translates into a response rate of 69%. There were no statistically significant differences between hospital respondents and non-respondents in terms of type of hospital, teaching status, hospital location, and hospital size [32]. The survey was administered between October 2006 and February 2007.

## 3.2 Survey Development

Development of the questionnaire was based on a survey of EHR trends and usage conducted by the Medical Records Institute [32]. Survey questions sought to determine the status of hospital-wide EHR implementation and the perceptions of HIM directors regarding the perceived motivating factors, benefits, and challenges of EHR implementation. Hospital demographic questions pertained to bed size and location. Respondents were presented with closed-ended or partially close-ended questions in which they had to check all the responses that were relevant. In the event that none of the predetermined choices applied, they were given the option to provide an open-ended response. To ensure that the questions would be clearly understood by the HIM directors, we pilot tested the survey among local HIM directors and made alterations where necessary.

## 3.3 Measures

Our dependent variables consisted of dichotomous variables (1 = yes; 0 = no) assessing perceptions of motivating factors (7 items), the expected benefits (6 items), and the barriers to EHR implementation (7 items) (► Table 1). The independent variable consisted of a dichotomous variable identifying the geographic location of the hospital (1 = rural; 0 = urban, suburban) based on responses to a survey question “Where is your hospital located?”

To account for other factors beyond geographic location that may explain the perceived differences in motivating factors, expected benefits, and barriers to EHR implementation, we employed as control variables, EHR implementation status, hospital type, bed size, and teaching status. EHR status was measured by a survey question: “Has your hospital implemented EHR?” Potential responses were affirmative (“Yes, EHR has already been implemented”), negative (“No, EHR has not been implemented”), or indicated partial implementation (“Implementation of EHR in progress”). Bed size consists of a categorical variable (less than 100, 100–199, 200–299, 300 or more beds) and was measured by a survey question: “What is your hospital size?” Hospital type consists of a categorical variable (government, not-for-profit, investor-owned for profit) and teaching status is identified by a dichotomous variable (1 = existence of residency programs; 0 = no). Hospital type and teaching status data were obtained from the American Hospital Association (AHA) Hospital Statistics.

## 3.4 Analyses

To rule out the presence of anomalous data for each variable, we ran simple descriptive statistics. Due to the dichotomous nature of the dependent variables (motivating factors, expected benefits, and barriers), we analyzed data using multivariate logistic regression in PASW Statistics version 18, formerly SPSS Statistics. We modeled the likelihood of rural versus urban hospitals (38 urban hospitals also includes 7 suburban hospitals) of agreeing with each of the items on perceived motivating factors, expected benefits, and benefits of EHR implementation. We employed as control variables, EHR implementation status, hospital type, bed size, and teaching status. Separate multivariate logistic regression models were run for each of the dependent variables. Statistical significance was considered if  $p < 0.05$  and within 95% confidence intervals.

# 4. Results

## 4.1 Characteristics of Hospital Respondents

Among the 91 respondent hospitals, about a quarter (26%) were not-for-profit hospitals, a little more than a third were investor-owned for-profit facilities (35%), and about two fifths (39%) were government owned facilities (► Table 2). With respect to hospital size, about half (47%) hospitals had 100 or fewer beds.

More than half (58%) were classified as being rural and 42% as urban and suburban hospitals. With respect to teaching status, 24% indicated they had medical residency programs. Mirroring national estimates [2, 6], 12% of hospitals in Alabama indicated having implemented some form of

EHRs. Of those, fewer rural hospitals (8%) have implemented EHRs as compared with urban hospitals (18%). About half (48%) of our sample of 91 hospitals did not have any EHR infrastructure in place, and 40% of hospitals revealed some degree of progress towards EHR implementation (► Table 2).

Results indicate that rural hospitals (64%) are smaller (those with less than 100 beds) compared to their urban/suburban counterparts (24%) ( $p < 0.001$ ). More teaching hospitals in Alabama were located in urban/suburban areas (46%) than rural areas (8%) ( $p < 0.001$ ) (► Table 2). There were no significant differences between rural and urban hospitals in terms of type of hospital (government, not-for-profit, for-profit) or EHR implementation.

## 4.2 Motivating Factors, Expected Benefits and Challenges of EHRs by Geographic Location

In univariate analysis (► Fig. 1), the three main factors all respondents chose as motivators of their hospital's need for EHR implementation mirrored national findings [3–5]:

1. to improve clinical or workflow efficiency (80% of respondents),
2. the need to share the patient record information among healthcare professionals (77%), and
3. EHR implementation can improve healthcare quality (73%).

In our multivariate logistic regression model, there were no significant differences between urban and rural hospitals on any of the motivating factors after controlling for EHR implementation status, hospital type, bed size, and teaching status (► Table 3). Among all hospitals, the major expected benefits of implementing EHRs were:

1. improvements to workflow (93%),
2. reduction in medical errors (67%),
3. reduction in costs (43%), and
4. reduction in treatment time/length of stay (43%) (► Fig. 2).

Results from multivariate logistic regression found that rural hospitals were 71% less likely to report cost reduction ( $OR = 0.29$ ,  $p = 0.036$ ) as a perceived benefit (► Table 3). Of all the hospitals in our sample, the three primary perceived challenges facing Alabama hospitals were:

1. lack of adequate funding or resources (75%),
2. lack of knowledge of EHRs (35%), and
3. lack of support from medical staff (33%) (► Fig. 3).

Multivariate logistic regression showed that rural hospitals were 75% less likely to report a lack of structured technology (such as drop down menus and semi-structured forms) ( $OR = 0.25$ ,  $p = 0.031$ ) as a perceived challenge (► Table 3).

## 5. Discussion

Despite concerted efforts by the federal government and relevant healthcare stakeholders to increase EHR implementation among rural hospitals nationwide, the rate at which EHRs have been implemented in rural facilities still lags behind their urban counterparts [2, 6, 33]. Additionally, although scholarly attention has been paid to the availability of EHRs in urban and rural locations, much is unknown about the motivating factors behind EHR implementation at rural hospitals; what they expect from EHR implementation, and their unique challenges because of their resource-deficient settings. Our results suggest that both urban and rural hospitals consider improvements in clinical or workflow efficiency as the primary motivator and benefit of EHR implementation. Our results also show that lack of adequate funding or resources is a major barrier to EHR implementation in both rural and urban hospitals.

Urban hospitals were more likely than rural hospitals to perceive a direct financial benefit from EHR implementation through lower costs. This may partially explain the lower EHR implemen-

tation among rural hospitals compared to urban hospitals. However, insufficient empirical evidence is available to support the perception among rural hospitals that EHRs are less likely to reduce costs than their urban counterparts. Further research is needed examining the impact of EHR implementation and meaningful use on costs, quality and patient safety. This empirical evidence will help substantiate the business case for EHR implementation.

Results from our study also suggest that the challenges to implementing EHR in Alabama's rural hospitals might be related to factors other than the availability of technological infrastructure. Consequently, meaningful use objectives and incentives offered by ARRA and other stakeholders might yield more visible results if directed at more appropriate needs in rural areas, such as personnel development and other non-technological priorities [22].

Other than these statistically significant results, there are additional factors across the rural-urban divide that play a practical role in EHR implementation. Both rural and urban hospitals claimed that desired improvements to clinical or workflow efficiency, sharing patient records among healthcare professionals, and improving healthcare quality were factors motivating the need for EHRs. These claims imply that hospitals are working towards ideals set forth in the Institute of Medicine reports *To Err is Human* [28] and *Crossing the Quality Chasm* [29]. Mirroring their aspirations for implementing EHRs, rural and urban hospitals indicated more often than other factors, improvements to workflow and a reduction in medical errors as benefits of EHR implementation. In ideal circumstances, EHRs would facilitate the sharing of patient records among healthcare professionals and this would lead to improvements in workflow and a decline in medical errors.

In comparison to other perceived challenges, rural and urban hospitals overwhelmingly claimed that lack of adequate funding or resources was the main impediment to EHR implementation. Accordingly, policy should be developed in a manner that aids the progress of implementing EHRs. Results from our study indicate that taking into account unique rural and urban characteristics that invariably accelerate or impede EHR implementation are necessary [22]. Special funding provisions exist for rural hospitals under the Health Information Technology for Economic and Clinical Health (HITECH) Act, the Medicare Rural Hospital Flexibility Grant Program, and the creation of Regional Extension Centers. While funding under the HITECH Act aims to bridge the digital divide between rural hospitals and their urban counterparts, some have argued it may actually exacerbate the digital divide since it does not differentiate between hospitals with systems already in place (as is usually the case in urban hospitals) and those who have to build their systems from the ground up (a common situation in rural hospitals) [22].

The following limitations of our study are worth noting. First, given the cross sectional nature of our study, any inference of causation should be avoided. Second, since data was collected from a single rural state, generalizing our findings to dissimilar states and geographic regions should be conducted with caution. Third, the potential variation in degrees of implementation was not fully captured by the limited range of response items, which was either affirmative ("yes"), negative ("no") or evolving ("in progress"). Fourth, since this is a preliminary and exploratory study, inferences derived should be treated with caution. Fifth, since research of electronic health records is a rapidly evolving field, our survey which was conducted about four years ago may not reflect current trends. Finally, our survey was intended for HIM directors in all hospitals in Alabama. Differing insights might have been obtained if we collected data from other health information management professionals with greater oversight on EHR implementation, such as Chief Information Officers or managers at the private companies tasked with implementing EHR for Alabama hospitals. Despite these limitations, our study fills an important literature gap. To our knowledge, this is the first study that examined the different perceptions of HIM Directors towards EHR implementation in a largely rural state such as Alabama. This study of HIM Directors is important because they are key decision makers in hospitals, and are involved in the day-to-day utilization of hospital medical records.

## 6. Conclusions

With Alabama being classified as a largely rural state [16], our study results suggest the risks confronting rural hospitals appear to be unrelated to a lack of technical expertise. As highlighted in the letter to the EHR vendor community from the National Coordinator for Health IT and the Director

of the Office of Minority Health, despite the promise of EHRs in alleviating chronic illness, mortality, and morbidity, providers to patients in “underserved communities” have been slower to implement EHRs [34]. As our study demonstrates, the perception among Alabama’s rural hospitals that EHRs might not reduce costs might be a reason why they have not been as prevalent as urban hospitals in implementing EHRs. Therefore, efforts to incentivize the implementation of EHR that in turn will facilitate “meaningful use” should focus on other non-infrastructure needs that Alabama’s rural hospitals might have, such as the need to train HIT personnel and the need to overcome opposition from medical staff. Further research should be concerned about other possible challenges facing Alabama rural hospitals.

In particular, a greater understanding by CMS and ONC of the unique challenges faced by rural hospitals in achieving universal meaningful use criteria, might lead to subsequent refinement of the objectives and criteria to motivate, not penalize, rural hospitals in their slower and more arduous process of implementing EHRs, as highlighted by recent research on the state of EHR adoption nationwide [33]. If applied without differentiating between rural and urban facilities, the penalties resulting from non-adoption of EHRs might result in counterproductive situations in which rural hospitals purchase EHR systems just to qualify for incentives or avoid penalties, but do not end up meaningfully using them. A recent announcement by the Department of Health and Human Services regarding the distribution of funds for Regional Extension Centers under the auspices of the HITECH Act enacted as part of ARRA, to assist rural hospitals to meaningfully use EHRs, is a step in the right direction [35]. In the case of resource-deficient rural hospitals, further research and fine tuning of meaningful use criteria should focus on the gap in rural hospitals between potential and actual (or expected versus observed) use of EHR systems, which has the potential to bring about significant clinical, social and economic transformation.

#### **Clinical Relevance Statement**

Taken in sum, these observations indicate that practitioners and patients of rural hospitals in Alabama would benefit if the aforementioned challenges towards achieving meaningful use of EHRs are overcome. Such challenges, unique to rural locales, deserve particular attention by policymakers since health outcomes do not compare favourably to urban facilities [36, 37]. If successfully adopted, practitioners and patients would greatly benefit from greater synchronization of care processes and a reduction in human medical errors, which are expected to lower overall costs in the long-term.

#### **Authorship**

All listed authors have made substantial contributions to: (1) conception and design, acquisition of data and/or analysis/interpretation of data and (2) drafting and/or critical revision of the article for important intellectual content. All listed authors in this manuscript have approved the version to be published.

#### **Conflict of Interest Statement**

The authors do not have any conflicts of interest or financial interests to disclose.

#### **Protection of Human Subjects and Animals in Research**

The procedures used in this study have been reviewed in compliance with ethical standards of the Institutional Review Board (IRB) by the University of Alabama at Birmingham, and with the World Association Declaration of Helsinki on Ethical Principles for Medical Research Involving Human Subjects.

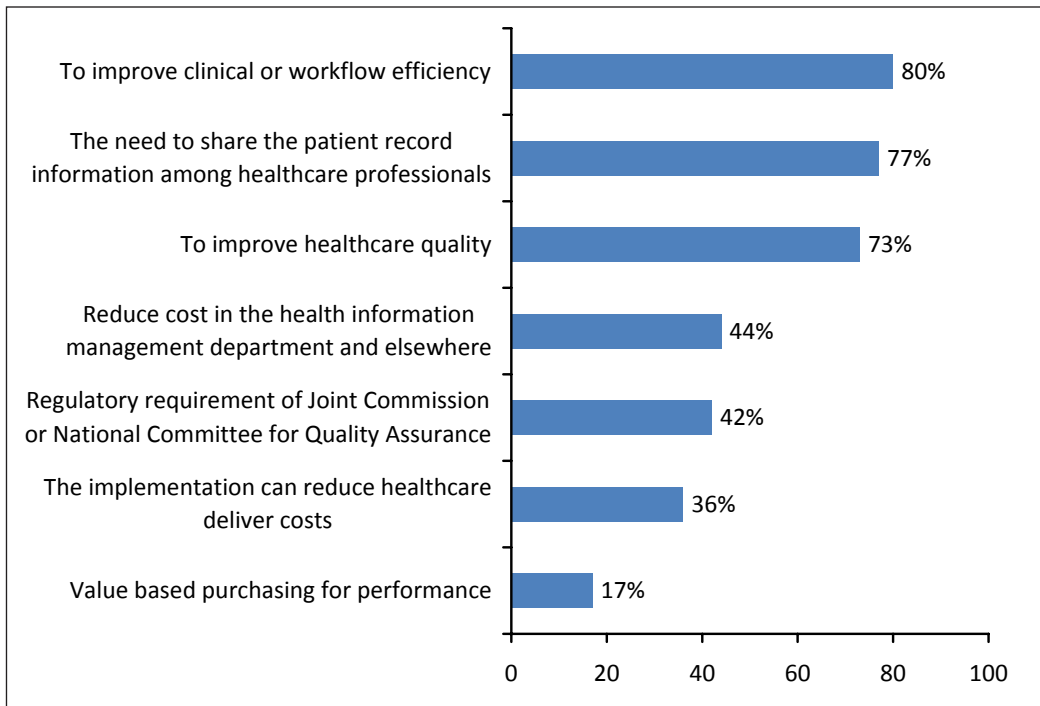


Fig. 1 Factors motivating the need for EHR implementation (all hospitals)

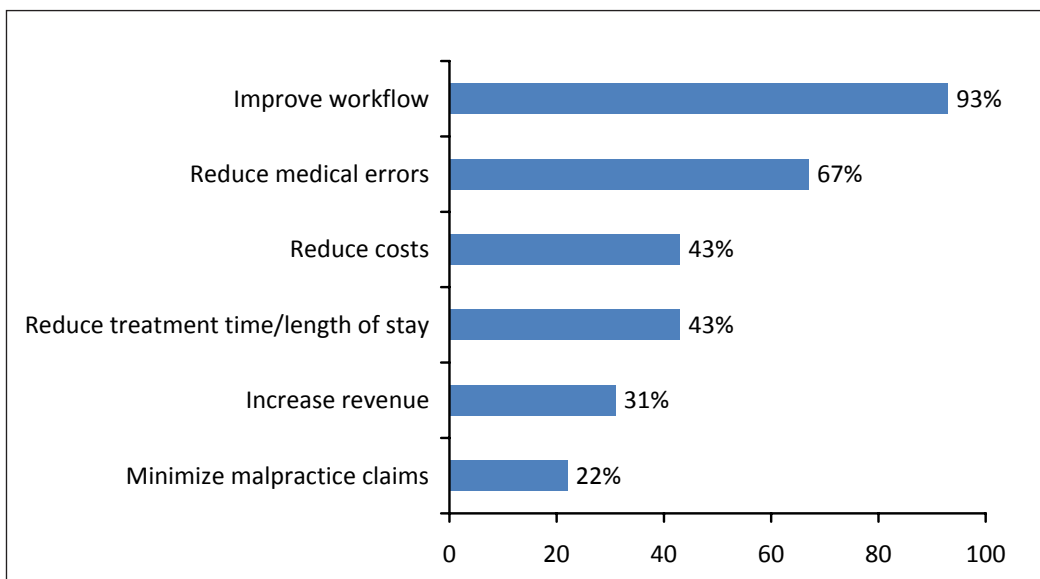
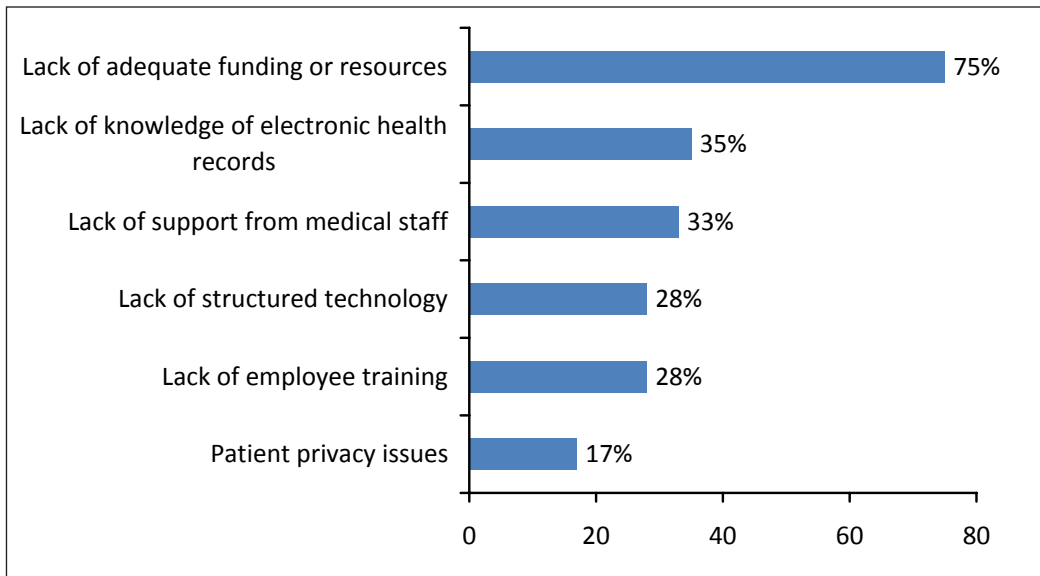


Fig. 2 Perceived benefits of EHR implementation (all hospitals)





**Fig. 3.** Barriers and perceived challenges of EHR implementation (all hospitals)

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**1. Motivating Factors**

**In your opinion, what factors drive the need for the EHR systems within your hospital? Select all that apply.**

- a. Regulatory requirements of the Joint Commission or National Committee for Quality Assurance
- b. Reduce cost in the Health Information Management department and elsewhere
- c. Value based purchasing for performance
- d. The need to share the patient record information among healthcare professionals
- e. The implementation can reduce healthcare delivery costs
- f. To improve healthcare quality
- g. To improve clinical process or workflow efficiency
- h. Other (please specify)

**2. Benefits**

**In your opinion, what are the benefits of implementing EHR at your hospital? Select all that apply.**

- a. Reducing treatment time/length of stay
- b. Increase revenue
- c. Reduce costs
- d. Minimizing malpractice claims
- e. Reduce medical errors
- f. Improved workflow
- g. Other (please specify)

**3. Challenges**

**What are the risks/barriers that the hospital has experienced with EHR implementation? Select all that apply.**

- a. Lack of adequate funding or resources
- b. Lack of support medical staff
- c. Inadequate or incomplete healthcare information standards or code sets
- d. Lack of structured technology
- e. Employee training
- f. Lack of knowledge of EHR
- g. Privacy issues
- h. Other (please specify)

**Table 1**

Questions from survey on motivating factors, benefits and challenges of electronic health records (EHR) implementation

**Table 2** Descriptive characteristics of hospitals participating in survey

Characteristics	All Survey Respondents (n = 91)	Hospitals in Urban/Suburban Areas (n = 38)	Hospitals in Rural Areas (n = 53)	p-value*
<b>Type of Hospital</b>				
● Government owned	35 (39%)	13 (35%)	22 (42%)	0.238
● Nongovernment not-for-profit	23 (26%)	13 (35%)	10 (19%)	
● Investor-owned for profit	31 (35%)	11 (30%)	20 (39%)	
<b>Hospital Size (beds)</b>				
● <100 beds	43 (47%)	9 (24%)	34 (64%)	<0.001**
● 100–199 beds	26 (29%)	10 (26%)	16 (30%)	
● 200–299 beds	11 (12%)	9 (24%)	2 (4%)	
● ≥300 beds	11 (12%)	10 (26%)	1 (2%)	
<b>Teaching Hospital</b>				
● Yes	21 (24%)	17 (46%)	4 (8%)	<0.001**
● No	68 (76%)	20 (54%)	48 (92%)	
<b>EHR Implementation Status</b>				
● Yes	11 (12%)	7 (18%)	4 (8%)	0.266
● No	44 (48%)	18 (47%)	26 (49%)	
● In progress	36 (40%)	13 (34)	23 (43%)	
Notes: *Chi-square test of overall rural/urban differences; **p<0.05; Numbers of subjects do not always add up to total sample size due to missing data.				

Motivating Factors	n = 91		
	OR*	95% CI	p-value
Regulatory requirement of Joint Commission or National Committee for Quality Assurance	0.61	0.20–1.83	0.376
Reduce cost in the health information management department and elsewhere	0.60	0.20–1.77	0.354
Value based purchasing for performance	1.52	0.34–6.87	0.585
The need to share the patient record information among healthcare professionals	1.22	0.35–4.22	0.756
The implementation can reduce healthcare delivery costs	0.95	0.31–2.98	0.935
To improve healthcare quality	1.18	0.35–3.94	0.790
To improve clinical or workflow efficiency	1.10	0.29–4.18	0.893
<b>Benefits</b>			
Reduce treatment time/length of stay	1.18	0.39–3.56	0.768
Increase revenue	0.51	0.16–1.60	0.249
Reduce costs	0.29	0.09–0.92	0.036**
Minimize malpractice claims	1.06	0.25–4.54	0.933
Reduce medical errors	1.59	0.50–5.05	0.431
Improve workflow	0.06	0.01–1.65	0.096
<b>Challenges</b>			
Lack of adequate funding or resources	0.69	0.20–2.42	0.563
Lack of support from medical staff	1.86	0.55–6.28	0.315
Inadequate or incomplete healthcare information standards or code sets	0.85	0.19–3.75	0.832
Lack of structured technology	0.25	0.07–0.88	0.031**
Lack of employee training	0.48	0.14–1.59	0.227
Lack of knowledge of EHR	0.97	0.31–2.97	0.952
Privacy issues	0.98	0.21–4.54	0.98
Notes: *Odds ratios: 1 = Rural, 0 = Urban. ** p<0.05 Controlling for hospital type, hospital size (beds), teaching status, and EHR implementation status.			

**Table 3**

Logistic regression for perceived motivational factors, benefits and challenges of EHR implementation

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