Implementation of Electronic Health Records (EHR) and its impact on readmissions and Total Performance Score (TPS): an analysis of American Hospital Association's (AHA) data

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Abstract

This study investigates the impact of EHR (Electronic Health Records) implementation on hospitals' readmissions and total performance score (TPS). Hospitals adopt and implement EHR to improve quality of care and improve patients' care process and experience. Data from American Hospital Association (AHA) and Centers for Medicare & Medicaid Services (CMS) are used to measure the impact of EHR implementation. The results show that EHR implementation increases readmissions in large hospitals and increases TPS scores in hospitals located in non-metro areas. The practical implications of the results are discussed in the paper.

Keywords: electronic health records, health information technology, readmissions, total performance score

1. Introduction

In the United States, healthcare costs consumers an ever-increasing amount of the nation's resources. One source of these rising healthcare costs is payment systems that reward medical inputs rather than outcomes. Medicare is transforming from a system that rewards volume of service to one that rewards efficient, effective care and reduces delivery system fragmentation. To advance this transformation, the Centers for Medicare & Medicaid Services (CMS) provides financial incentives to hospitals based on their performance on selected quality measures. These measures include evaluations of hospitals' clinical process of care, patient perspective of care, outcomes, and efficiency. CMS aims to reward hospitals that can provide efficient care at a lower cost to Medicare. The Interoperability and Patient Access final rule (CMS-9115-F) delivers on the Administration's promise to put patients first, giving them access to their health information when they need it most and in ways they can best use it.

Lack of seamless data exchange in healthcare has historically detracted from patient care, leading to poor health outcomes, and higher costs. The CMS Interoperability and Patient Access final rule establishes policies that break down barriers in the nation's health system to enable better patient access to their health information, improve interoperability and unleash innovation, while reducing burden on payers and providers. Patients and their healthcare providers will have the opportunity to be more informed, which can lead to better care and improved patient outcomes, while at the same time reducing burden. This rule finalizes new policies that help liberate health information and move the healthcare system toward greater interoperability.

Health information technology (HIT) plays an important role in improving healthcare delivery and communication among members of the healthcare team. Some examples of HIT are electronic health records (EHR), computerized physician order entry (CPOE), and clinical decision support systems (CDSS) (Pisonneault et al., 2017). The electronic health record is linked to the after-visit summary and the patient portal. The after-visit summary (AVS) is a document that informs patients about their health issues by reinforcing important self-management tasks, clarifying health information, and providing education (Federman et al., 2016). A patient portal is a secure website for patients that offers a variety of features linked to a physician's EHR including secure messaging, protected health information (lab results, medication lists, and immunizations), appointment scheduling, PHRs (personal health records), programs for self-management, and patient questionnaires (Otte-Trojel et al., 2014). In terms of patient care, implementing HIT results in improved quality of patient care, leading to better health outcomes and patient satisfaction. Because patients are able to access their records, they have more control over their medical care, which in turn increases their confidence in having better care.

EHR may have negative consequences for healthcare providers and patients. Negative impact of EHR implementation includes longer wait times, racial and socioeconomic disparities, and provider and

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patient dissatisfaction. Lack of strategically designed care process to meet goals and address needs and fragmented EHR systems across hospitals make the use of EHR confusing, disconnected, and a burden on the hospitals and healthcare providers (Tierney et al, 2015). In some cases, older, non-white, less-educated, lower income patients with poor health and living in nonmetropolitan areas have been offered portal access less often and have not fully benefitted from the electronic health services (Peacock et al, 2016). Providers may find new EHR documentation requirements and navigation difficulties challenging and become less productive, and as a result, patients would not be satisfied with the care they have received (Meyerhoefer et al., 2018).

The main objective of this research is to measure the impact of EHR implementations in the hospitals on quality of care and patients' satisfaction. Literature review of EHR implementation and the themes identified are presented next followed by hypotheses, method, and data analysis. The paper concludes with the discussion of results and their practical implications.

2. Literature review and themes

EHRs are highly regarded as a valuable tool in healthcare. The review of the prior literature on EHR implementation and its relevant innovative technologies reveals nine themes. Below the themes and the papers in each theme are explained. The themes are data quality, adoption and resistance, cost and quality improvement, improved continuity of care, healthcare delivery, patient involvement, active participation in decision-making, improved patient-provider relationship, and improved patient satisfaction (see Table 1).

Table 1. EHR themes in the literature: select articles with the titles and description of the themes.

Theme	Description	Papers
Data Quality	Data Breaches, Integrity, Quality, and Completeness of EHRs	(Burns et al. 2015) (Kwon and Johnson 2018) (Liu et al. 2017) (Menachemi and Collum 2011)
Adoption and Resistance	Adoption and Resistance of EHR and related innovative technologies at the user and hospital levels.	(Samhan and Joshi 2019) (Lewis et al. 2009) (Wu et al. 2009)
Cost and Quality Improvement	Challenges, benefits, and insights of using EHR solutions in reducing cost and increasing quality of care.	(Byrd and Byrd 2009) (Basole and Rouse 2009) (Vroegindeweij and Carvalho 2019) (Sherer 2014) (Karlsen et al. 2019)
Improved continuity of care	Information exchange from EHRs improves continuity of care through patient-provider communication.	(Pisonneault et al. 2017) (Bao et al. 2020) (Otte-Trojel et al. 2014)
Healthcare Delivery	Use of innovative and emerging technologies in enhanced, effective, and safe delivery of healthcare	(Fernández 2017) (Conway et al. 2017) (Chen et al. 2019) (Avgar et al. 2018)
Patient Involvement	Improving patient's involvement and participation with health systems.	(Yaraghi et al. 2019) (Karahanna et al. 2019) (Vassilakopoulou et al. 2016) (Djamasbi et al. 2009)
Active patient participation in decision making	Having more control over their health records results in being more confident about their care.	(Otte-Trojel et al. 2014) (Giardina et al. 2014) (Peacock et al. 2016) (Wolff et al. 2016)
Improved patient-provider relationship	HIT improves patient-provider relationships through information exchange.	(O'Malley et al. 2015) (Bao et al. 2020) (Pisonneault et al. 2017) (Otte-Trojel et al. 2014)
Improved patient satisfaction	Access to records and telemedicine improves patient satisfaction.	(Peacock et al. 2016) (Wolff et al. 2016) (Bao et al. 2020)

2.1 Theme 1: Data Quality

Under this theme the papers investigate data quality that encapsulates the crucial aspects of data completeness, accuracy, and consistency, data integrity, and data security. The papers under this theme scrutinize the imperativeness of optimal data quality of healthcare records and its impact on clinical decisions, public health monitoring, and health services planning. Liu et al. (2017) summarize the meaningful storage and usage of data for better clinical decision-making and further enhancement of healthcare services. Poor data quality leads to an increase in mortality rate and loss of revenue, hence some governments commit to electronic health records (EHR) systems and supporting technologies (Menachemi and Collum 2011). Under the Health

Information technology for economic & clinical health (HITECH) Act, the U.S. government is incentivizing the efficacious use of healthcare IT systems to implement EHRs. Data security is a vital issue discussed in this theme (Hewitt 2009). Privacy breaches and medical identity theft are the most looming issues. The Technology Acceptance Model (TAM) is used to assess the slow adoption of EHR, biometric technology, single sign-on, and multiple sign-in systems. Cost, usefulness, compliance, and security issues are important factors investigated in this theme. Investment in improving data quality saves lives, reduces errors and data breaches, proves beneficial for hospitals and patients, and opens new avenues for medical research and discoveries.

2.2 Theme 2: Adoption and Resistance

Under this theme resistance to the usage and implementation of EHR are investigated. The User Resistance Model (USR) is used in the context of Health Information Technology (HIT) with the focus on the adoption of EHR systems by physicians in developed and developing countries and providing results to facilitate the successful implementation of EHR (Samhan and Joshi 2019). The theme suggests that it is essential to make refinements to the EHR systems and working models to make them more befitting to the new context of healthcare data recording and usage. Diligent effort should be put into promoting and encouraging the adoption of EHR through incentivization/ penalizing or enforcing mandates for efficient adoption of the EHR system. It is strongly advised that EHR designers should make interfaces simple for ease of learning and application by the physicians, even the ones who are not technologically adept. This theme highlights strategic use of innovative technologies such as RFID-enabled strategic systems with an aim to benefit the healthcare organizations (Lewis et al. 2009). An effective approach to measure the e-health readiness required by a healthcare organization is to provide a conceptual model that measures the impact of e-health systems on the desired transformation success (Wu et al. 2009).

2.3 Theme 3: Cost and Quality Improvement

Under this theme key insights are provided to implement IT solutions for cost reduction and care quality improvement as well as the challenges faced to do so. IT strategies and tools which can be used to reduce costs and improve care quality are discussed in this theme. The use of IT in other industries has helped companies in operational cost reduction. The cost and benefit of using IT applications by the hospitals and their impact are investigated in this theme (Byrd and Byrd 2009). Mobile computing is believed to provide swift and efficient care at low costs. A survey of healthcare CIOs and the determination of the relative importance of each of the readiness dimensions and quality assessment indicators are discussed in this theme and benchmark metrics are provided to differentiate among healthcare organizations of different sizes, types, and other demographics for supporting health IT innovation and readiness (Basole and Rouse 2009). Cognitive computing systems such as IBM Watson can be used along with EHRs, to demonstrate and favor the evidence-based decision making to improve the outcomes of the practice hence making the quality of care better (Vroegindeweij and Carvalho 2019). The relevant metrics of health IT with theoretical and philosophical underpinnings should be used to measure the benefit of IT in improving care quality (Sherer 2014). The contextual and operational factors are important in the success of health IT solutions such as telecare services (Karlsen et al. 2019).

2.4 Theme 4: Improved Continuity of Care

Under this theme continuity of care is defined as a multidimensional construct that reflects a patient's perception that providers know what has happened before (informational continuity), that different providers agree on a management plan (management continuity), and that a provider who knows them will care for them in the future (relational continuity) (Pinsonneault et al., 2017). In other words, the information exchange that an EHR provides, such as secure messaging, allows caregivers to educate their patients on the importance of adhering to their medical regimen, which in turn, enables providers to evaluate disease progression accurately and make appropriate medication recommendations (Bao et al., 2020). Having a method of communication improves continuity of care through an improved relationship between the patient and healthcare provider. As Otte-Trojel et al. (2014) state, patient portals allow patients to communicate asynchronously with a preferred provider, enabling them to build an ongoing, personal relationship that includes mutual trust and responsibility. Interpersonal continuity of care was suggested to improve clinical outcomes and patient satisfaction in some studies, whereas patient-provider communication alone was linked to interpersonal continuity of care in more than 50% of the studies.

2.5 Theme 5: Healthcare Delivery

Under this theme emerging technologies are discussed in relation to the enhancement of healthcare delivery. Innovation and investment in Health IT are supported for the purpose of research, discovery, and enhanced healthcare delivery (Fernández 2017). Constraints such as tight budgets and uncertain regulatory environments make the need for innovation and new technology adoption very important. The importance of leadership and systems thinking as foundational elements for promoting patient safety is highlighted in this theme (Conway et al. 2017). Ongoing research on Health Information Systems (HIS) and intellectual its structure can provide opportunities for future research in this area (Chen et al. 2019). Furthermore, the impact of work practices on adopting the new technology systems in healthcare domain are further discussed in this theme which sheds light on the changes required at the workplace for deriving the benefits of Health IT and delivering high quality healthcare (Avgar et al. 2018).

2.6 Theme 6: Patient Involvement

Under this theme the impact of digital health services on patients is investigated. Hospitals benefit from Health IT solutions which leads to better patient's interactions with the systems and healthcare providers and the digital advantage improves the patient involvement and in turn benefits both the health organizations and the end patients. If patients disclose their information to Health Information Exchange (HIE) platforms, the hospitals can use that information to better serve them and analyze trends. Patient's participation and engagement with healthcare systems, such as providing health data on HIE platforms, and it is essential to encourage patients to use the system and communicate the benefits (Yaraghi et al. 2019). Leverage on digital advantage is correlated to economic capital, social capital, knowledge spread, and knowledge stock and hospital digital advantage is positively associated with hospital performance (Karahanna et al. 2019). The design of electronic services plays a vital role in its success (Vassilakopoulou et al. 2016) and patient's attitude towards those healthcare systems is an important factor in the acceptance and use of healthcare information systems (Djamasbi et al. 2009).

2.7 Theme 7: Active patient participation in decision making

Under this theme the patients' access to and control over their health data and its impact are discussed. When patients have access to their records, they feel more empowered to have control over their care and have more confidence in managing their care. Making electronic health records available to patients allows them to actively participate in their care process and make informed decisions for their health (Otte-Trojel et al., 2014). Compared to the control group, patients who had their full antenatal records felt more in control of their pregnancies and more relaxed talking to doctors and midwives (Giardina et al., 2014). Having a more active role in decision-making motivates patients to be more confident in having better care. Peacock et al. (2016) suggest that when patients have access to doctors' clinical visit notes, they are more informed about their care, remember what to discuss during doctor visits, feel more in control of their medical care, and improve their medication adherence. Awareness and knowledge gained by patients with access to their health information give them good reasons to trust their healthcare providers and engage in the care process (Wolff et al., 2016).

2.8 Theme 8: Improved patient-provider relationship

Under this theme the relationships between patients and healthcare providers are investigated in the context of EHR usage and implementation. Communication between healthcare providers is enhanced by EHR-based systems with necessary access to patient information, instant messaging, task assignment, and clinical notes (O'Malley et al., 2015). The information exchange between the patient and provider is also improved due to the adoption of EHRs. The use of health portal's clinical functions, such as access to test results and medical history (health issues, immunizations, and allergies), can yield greater accuracy and consistency of information for both providers and patients (Bao et al., 2020) and helps physicians better learn about their patients' disease, treatment, and behavior patterns (Pisonneault et al., 2017). Similarly, digital portals enable patients to access and review their medical records and test results, reflect on them, and then decide how to engage with providers and whether or not to continue their treatment.

2.9 Theme 9: Improved patient satisfaction

Under this theme the impact of EHR systems on patient's experience is discussed further. Overall, EHR implementation is linked to improved patient satisfaction. Majority of patients find it very important and useful to access their health records electronically (Peacock et al. 2016). Having access to their records led patients to become more confident in managing

their health information and care, better prepared for office visits, and have a better understanding of their plan of care (Wolff et al., 2016). Patient portals are also convenient in that patients can receive care from the comfort of their own home. Telemedicine allows patients to communicate with healthcare providers and receive the care they need. These types of services that health portals offer create a convenient and satisfactory experience for the patients (Bao et al., 2020). A positive patient's experience is characterized by fast delivery of high-quality care with transparency and immediate access to any medical and health information.

3. Hypotheses

Two main hypotheses are developed based on the prior literature and this study's research objectives to measure the impact of EHR implementation in hospitals on the quality of care that hospitals provide for the patients and the patients' experience of the care that is provided for them.

Improved and consistent continuity of care provided by the hospitals, cost-efficient and high-quality care provided for the patients, and healthcare processes that are managed and enhanced to deliver the best outcome help hospitals to provide healthcare services for the patients that address their needs, concerns, and improves their clinical and psychological health conditions. Such healthcare services reduce readmissions to the hospitals and allow hospitals to maintain patient-centric applications of the healthcare systems.

CMS defines hospital readmission as an admission to an acute care hospital within 30 days of discharge from the same or another acute care hospital for any reason. Previous research has shown mixed results regarding the impact of EHR implementation on readmissions. Some research show that EHRs can reduce readmissions (Wani & Malhotra, 2018), while others argue that using EHRs does not improve a hospital's ability to decrease 30-day readmission rates (Patterson et al., 2014; Elysee et al., 2021; Mirani & Harpalani, 2015). Meaningful EHR assimilators have an average of a 6.5% decrease in readmission rate compared to non-adopters and partial adopters (Wani & Malhotra, 2018). In addition, implementing EHRs in hospitals can potentially reduce readmission rates through improved medication reconciliation at discharge and error-free prescriptions and medications (Patterson et al., 2014).

Some research show that EHR adoption is not associated with decreased readmissions. Compared to hospitals with no EHRs, the hospitals with EHRs would have similar readmission rates without any statistically significant differences or results (Mirani et al., 2015; Patterson et al., 2014). Implementation of EHR systems may not be associated with readmission rates due to low quality of implementation, misalignment between EHR and hospital processes, lack of interoperability between different platforms and systems across the hospitals, and disengaged patients (Elysee et al., 2021). Interoperability between health systems is disrupted when data is not standardized in a way that is easily understandable. Although information in EHR systems may be effective and error-free, that alone may not be sufficient in reducing the risk of readmission. Patient engagement with the technologies and technological capabilities that would complement and assist the usage and applications of EHR systems such as patient portals, and secure messaging are also needed to lower readmission risk. Therefore:

Hypothesis 1 (H1): Implementation of EHR lowers hospital readmissions or does not have any impact

In the new patient-centric care model, patients are empowered with the help of new technologies to actively participate in their care process in conjunction with their healthcare providers. Improved communication and empathetic relationship between doctors and patients that involve patients in the decision making about their health, improves patients' satisfaction toward the care they receive at the hospitals. Healthcare systems that facilitate a better relationship between patients and their healthcare providers help provide a positive experience for the patients.

The CMS total performance score (TPS) is used to measure patient satisfaction. According to CMS, TPS includes 4 components: clinical outcomes, person and community engagement, safety, efficiency, and cost reduction. Past research has shown mixed results regarding the association between EHR implementation and TPS. This can be due to the variation in EHR system cost, options, ease of use, training requirements, and on-site and follow-up support (Beauvais et al., 2021). Results from some studies show that using EHR would result in higher TPS (Wang & Gibbs, 2019; Beauvais et al., 2021), whereas other studies suggested that adopting EHRs may not improve TPS (Trout et al, 2022; Wang & Gibbs, 2019; Beauvais et al., 2021). Some EHR vendors' applications such as Cerner and Epic may have a positive impact on efficiency and quality scores than others (Beauvais et al., 2021).

On the other hand, implementing EHRs may not result in higher TPS scores. For some hospitals the meaningful use of EHR systems would have a limited

positive impact on only two patient safety outcomes in the TPS scores, suggesting that hospitals may not see significant improvements (Trout et al, 2022). Potential problems such as alert fatigue in clinical decision support systems (CDSS), interoperability issues, and inappropriate document capture may hinder positive impact of EHR systems. Therefore:

Hypothesis 2 (H2): Implementation of EHR increases TPS scores or does not have any impact

4. Method

Data from American Hospital Association's (AHA) 2015-2016 dataset is merged with the 2015-2016 data from Centers for Medicare & Medicaid Services (CMS) to test the hypotheses and measure the impact of EHR implementation on readmissions and TPS scores (see Table 2). The AHA data was purchased from the American Hospital Association's data services and CMS data was collected from their publicly available data on their website. The AHA dataset captures the structural, financial, and technical aspects of the hospitals including EHR systems. The CMS data includes patient and quality of care attributes that are necessary to investigate the impact of EHR systems on health outcomes and services. The merged AHA and CMS dataset provided the full picture to test the hypotheses.

The merged dataset has 192 cases for 192 hospitals across the U.S. After the removal of missing and incomplete cases there are 118 cases in the final dataset. CMS and AHA data are merged into one dataset based on the hospitals' unique identifier Provider ID. Hospital names in the CMS dataset are matched with exact hospital names in the AHA dataset using the same Provider ID. R studio is used for data analysis. Multiple regression analyses with standardized continuous variables are performed to test the hypotheses. Variables and their descriptions are provided in Table 2.

Table 2. Variables of the research model

Variable	Description
Predictor	
EHR implementation	Does your hospital have an electronic health record (EHR)? No (0), partially implemented (1), fully implemented (2)
Outcome variables	
Number of Readmissions	Number of Readmissions for AMI (Acute Myocardial Infarction), CABG (Coronary Artery Bypass Graft), COPD (chronic obstructive pulmonary disease), HF (heart failure), hip/knee replacement, and PN (pneumonia).
Total Performance Score	Total Performance Score (TPS) includes the following: Clinical Care-Process domain score, Clinical Care-Outcomes, the Patient and Caregiver-Centered Experience of Care/Care Coordination domain score, the Safety domain score, and the Efficiency and Cost Reduction domain score.
Control variables	
Size	Total hospital unit beds set up and staffed
Location	Core-Based Statistical Area Type Metro, Rural;
Control (Authority/Policy)	The type of organization responsible for establishing policy concerning the overall operation of the hospital. Nongovernment (not-for-profit), Investor-owned (for-profit)

5. Research Model

Two regression models with one predictor and three control variables are developed to test the impact of EHR implementation on readmissions and TPS (see Figure 1). The control variables are total hospital beds, location of the hospitals, and the hospital's type of authority and policy (see Table 2). The equations of the regression models are as follows:

$$\text{Readmissions}_i = \beta_0 + \beta_{1i} * EHR_i + \beta_{2i} * Size_i + \beta_{3i} * Location_i + \beta_{4i} * Control_i + \varepsilon_i$$

$$\text{TotalPerformanceScore}_i = \beta_0 + \beta_{1i} * EHR_i + \beta_{2i} * Size_i + \beta_{3i} * Location_i + \beta_{4i} * Control_i + \varepsilon_i$$

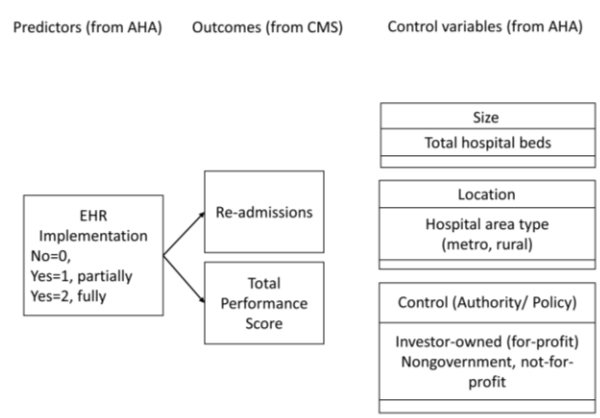

Figure 1. Research Model

5.1 Regression Assumptions

Regression models are tested to test for regression assumptions. The multicollinearity of the regression model is tested by estimating the value of variance inflation factor (VIF) which is an indication of the extent to which regression coefficients are inflated because of multicollinearity. The VIF value of 1 means no multicollinearity and the VIF value that is greater than 5 shows some levels of collinearity in the regression models between the predictors. The VIF values for the predictors in the multiple regression models are provided in Table 3. The VIF tests for the readmissions and total performance score models show that no predictors have a VIF value over 2.5. Therefore, there is no multicollinearity in the models

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Table 3. Multicollinearity test and VIF scores

Predictor variables	VIF
EHLTH	1.021
HOSPBD	1.144
Location Metro	1.314
Location Rural	1.252
Control Nongovernment (not-for-profit)	1.732
Control Investor-owned (for-profit)	1.668

5.2 Results

Regression results are provided in Tables 4 and 5. The results show that EHR implementation is positively associated with readmissions with the coefficient (SE) of 77.682 (39.755). In the same model hospital bed size is positively associated with readmissions with the coefficient (SE) of 0.658 (0.053). These results show that EHR implementation in large hospitals increase readmissions (see Table 4) which does not support hypothesis H1. The initial implication of these results is that the implementation of the EHR systems are successful in improving hospital's care delivery if it is aligned with the size of the hospital and their service capacity otherwise the impact of EHR systems might be reversed. The other control variables, location of hospitals (rural or metro) and operational and policy controls (not for profit and for profit) are not significantly associated with the number of readmissions. In section 6 these results and their implications are discussed at length and in depth.

EHR implementation is negatively associated with TPS scores with the coefficient (SE) of -4.306 (2.035). In the same model location metro is negatively associated with TPS with the coefficient (SE) of -6.971 (2.399). These results show that EHR implementation in the hospitals located in metro areas reduce TPS and in non-metro areas can potentially increase TPS scores (see Table 5) which partially supports hypothesis H2. The first-hand implication of these results is that the EHR implementation in the hospitals that are located in the areas with large metro population may not be able to provide a positive care experience for the patients. Large populations exponentially increase demands for medical services which negatively affects the quality of the care that is provided. The other control variables, location of hospitals (rural) and operational and policy controls (not for profit and for profit) are not significantly associated with the TPS score.

The further discussion of these results and their implications are provided in the next section.

Table 4. ***Regression results for the outcome variable Number of Readmissions***
P values: <.1*, <.01**, <.001***

Predictors	Coefficient	Standard Error	P-Value
EHLTH	77.682	39.755	0.052*
HOSPBD	0.658	0.053	0.000 ***
Location metro	42.220	51.563	0.414
Location rural	-5.777	88.995	0.948
Control nongovernment (not-for-profit)	48.298	63.763	0.450
Control investor-owned (for-profit)	-29.500	84.787	0.728

Table 5. ***Regression results for the outcome variable TPS***
P values: <.1*, <.01**, <.001***

Predictors	Coefficient	Standard Error	P-Value
EHLTH	-4.306	2.035	0.036 *
HOSPBD	-0.001	0.002	0.597
Location metro	-6.971	2.399	0.004 **
Location rural	3.098	4.854	0.525
Control nongovernment (not-for-profit)	2.196	3.196	0.493
Control investor-owned (for-profit)	-7.193	4.616	0.122

6. Discussion of Results

The success of EHR implementation depends on strategic alignment and organizational interoperability of those systems. EHR implementation by itself may not result in positive outcomes for the hospitals and patients. Empirical results of this study show that hospitals may not achieve the positive outcomes expected from the implementation of the EHR systems. These counter-intuitive results highlight the importance of the factors that may negatively reduce the positive impact of EHR systems. The service capacity and useful functions of the systems should be implemented and used in accordance with the population of the area where the hospital is located and

the size of the hospital and the number of patients the system can support.

Empirical results of this study show that EHR implementation increases readmissions. Hospital bed size is an important factor in the success of the EHR systems. It is evident that large hospitals need to provide healthcare services of different kinds to a larger number of patients and manage a more complex hospital-wide enterprise system. Readmissions are reduced if patients receive high quality care. Once patients are released from the hospitals, it is important to ensure they are going to be able to perform self-management activities on their own and away from the hospital such as taking medications and adherence with prescribed treatments and managing the psychological consequences of their health conditions. EHR systems should enable these self-management services. EHR in larger hospitals would be less effective in achieving the goal of lowering readmission unless those systems are used with proportionate infrastructure capacity and scalable digital architecture. Interoperability of EHR systems in a network of enterprise applications and systems across different hospital units and services provides functional and operational efficiencies in the care process that can reduce readmission rate and shift the burden of the patient health management from hospitals to patient-provider collaboration. Service disruptions and disjointed care processes that are more common in larger hospitals reverse the potential positive impact of the EHR systems.

Results of this study provide another important insight into the implementation of EHR systems and its impact on patient's satisfaction and experience, quality of care, and clinical and financial outcomes summarized in TPS scores. The results show that TPS scores are reduced in hospitals that have implemented EHR systems. Hospitals that are located in metro areas are less likely to see positive clinical, financial, patient experience TPS scores. Metropolitan Statistical Area is defined by the U.S. Census agency as counties associated with at least one urbanized area with the population of 50000 or more and well-integrated socio-economic structures. The service demand of a large population of patients that surpass the digital capacity of hospitals located in metro areas reduce the likelihood of providing a positive and effective care. The high patient-provider ratio puts pressure on healthcare providers to save time and provide care for a larger number of patients and likely spend less time with each patient. Literature shows that understanding health conditions and the reasons behind treatments are very important for the satisfactory experience of the patients in the care process.

EHR systems cannot fully replace the patient-provider relationship but can strengthen and enhance it. Implementation of EHR systems should be viewed in the broad continuum of care from initial assessment and communications between patients and providers, through diagnosis and treatment, to continuous monitoring and long-term management of the health condition post-diagnosis. Amazon's recent purchase of One Medical in the U.S. is one step toward the success of EHR systems with democratized care and technological capacity for a larger number of people that provides readily available access to information about diseases and treatments, and continues communication between patients and providers. When patients can conveniently access their medical records, feel empowered to have control over their care, and are helped to manage the psychological aspects of managing their health conditions and diseases, they will have a more positive and satisfactory experience with their care process. EHR systems should pursue and implicate those goals in their designs, usage, and more importantly implementations.

7. Limitations

This study faces a few limitations. Technological advancements happen fast and frequently. The healthcare systems such as Medical One are revolutionary ideas that should be included in the studies that investigate effective and successful implementation of EHR systems. Empirical data that are used to test research hypotheses in this study were limited to the merger of different datasets and hence reduced in size. Future studies of this kind may include a larger number of cases and variables in the data analysis with specific comparisons between hospitals of different sizes located in rural and metro areas in different U.S. states and countries to ensure more inclusive results and generalizable implications. It is important to identify the characteristics and issues in large hospitals and those located in the metro or rural areas that may have impact on the success of the implementation of EHR systems.

8. Conclusion

Successful implementation, management, and long-term maintenance of EHR systems is complex and multifaceted. Hospitals use EHR systems to save money, and improve quality and experience of care for their patients. EHR systems do not inherently improve care processes and need careful and strategic implementation that aligns with the size and location of the hospitals, its organizational, resources, and

technological capacity and interoperable enterprise-wide integration. Hospitals with EHR systems that provide care for large population of patients may not gain positive outcomes if they assume digital tools inherently produce positive results. Positive patient experience and health outcomes at hospitals with EHR systems depends on the empathic and continuous relationship between patients and healthcare providers in which patients are actively involved in their care process, can access their health information and understand it, are continuously monitored and empowered to self-manage their health conditions in the absence of care providers, and receive multi-channel communications about their disease and treatments from their providers. Implementation of EHR systems in hospitals should be scalable, adaptive to and compatible with the broad continuum of care from initial assessment, diagnosis and treatment, to post-diagnosis self-management of the health conditions.

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