Environmental market factors associated with EHR adoption among cancer hospitals

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This work was supported by the National Cancer Institute Cancer Prevention and Control Training Program Grant R25 CA04788.

Institutional review board approval was received from the University of Alabama at Birmingham_s Human Subjects Committee.

The authors have disclosed that they have no significant relationship with, or financial interest in, any commercial companies pertaining to this article.

This is the author's manuscript of the article published in final edited form as:

Tarver, W. L., & Menachemi, N. (2018). Environmental market factors associated with electronic health record adoption among cancer hospitals. Health Care Management Review, Publish Ahead of Print. https://doi.org/10.1097/HMR.0000000000000149

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Abstract

Background: While recent literature has explored the relationship between various environmental market characteristics and the adoption of EHRs among general, acute care hospitals; no such research currently exists for specialty hospitals, including those providing cancer care.

Purpose: To examine the relationship between market characteristics and the adoption of EHRs among Commission-on-Cancer (CoC)-accredited hospitals.

Methods/Approach: Secondary data on EHR adoption combined with hospital and environmental market characteristics were analyzed using logistic regression. Using Resource Dependence Theory, we examined how measures of munificence, complexity, and dynamism are related to the adoption of EHRs among CoC-accredited hospitals, and separately, hospitals not CoC-accredited.

Findings: In a sample of 2,670 hospitals, 141 (0.05%) were academic-based CoC-accredited and 562 (21%) were community-based CoC-accredited hospitals. Measures of munificence such as cancer incidence rates (OR=0.99; CI [0.99-1.00]; p=0.020) and percentage population aged 65+ (OR=0.99; CI [0.99-1.00]; p=0.001) were negatively associated with basic EHR adoption while urban location was positively associated with comprehensive EHR adoption (OR=3.07; CI [0.89-10.61]; p=0.076) for community-based CoC-accredited hospitals. Measures of complexity such as hospitals in areas with less competition were less likely to adopt a basic EHR (OR=0.33; CI [0.19-0.96]; p=0.005) while Medicare Managed Care penetration was positively associated with comprehensive EHR adoption (OR=1.02; CI [1.00-1.05]; p=0.070) among community-based CoC-accredited hospitals. Lastly, dynamism, measured as population change was negatively associated with the adoption of comprehensive EHRs (OR=0.99; CI [0.99-1.00]; p=0.070) among academic-based CoC-accredited hospitals.

Practice implications: A greater understanding of the environment's relationship to HIT adoption in cancer hospitals will help stakeholders in these institutions make informed strategic decisions about IT investments guided by their facilities' respective environmental factors. The results of this study may also be useful to hospital chief information officers and chief executive officers seeking to either improve their quality of care or achieve and maintain accreditation in providing cancer care.

Keywords: Health information technology, electronic health records, market factors, cancer hospitals

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Introduction

For cancer hospitals, there is an increased emphasis on quality of care which largely impacts patient outcomes ranging from their quality-of-life to their chances of cancer recurrence (Hewitt & Simone, 1999; Levit, Balogh, Nass, & Ganz, 2013). Previous literature draws attention to the fact that hospitals vary widely in their ability to provide quality cancer care (Hewitt & Simone, 1999). Much attention has been given to health information technology's (HIT) role in quality improvement (Bates & Gawande, 2003; Buntin, Burke, Hoaglin, & Blumenthal, 2011), and the Institute of Medicine acknowledges the use of HIT systems as one of the six components to improve the quality of cancer care (Levit et al., 2013). Although the use of HIT applications such as electronic health records (EHRs) has been widely cited as a means to improve cancer care due to improved decision support and improved health information exchange (Clauser, Wagner, Aiello Bowles, Tuzzio, & Greene, 2011; Hesse, Hanna, Massett, & Hesse, 2010; Levit et al., 2013); the presence of these systems in hospitals providing cancer care is lacking. In addition, robust HIT adoption rates continue to lag in cancer hospitals even with the enactment of the Health Information for Technological and Clinical Health (HITECH) Act which uses incentives to alleviate the financial burden of HIT adoption.

The slow uptake of HIT may be a function of organizational and market factors which may serve as facilitators and barriers to hospitals opting to computerize. The health care management literature gives attention to the influence of external environmental factors and posits that managerial decisions (e.g., IT investments) are affected by the level of uncertainty regarding, and the abundance of resources in, their organization's environment (Begun & Kaissi, 2004). In addition, recent literature has drawn attention to the relationship between HIT adoption and the market environment (Menachemi, Mazurenko, Kazley, Diana, & Ford, 2012; Menachemi, Shin, Ford, & Yu, 2011). For example, HIT adoption in hospitals was negatively associated with factors conceptualized as contributing to uncertainty in the environment such as unemployment rates and poverty rates (Menachemi et al., 2012). Previous work examining market factors related to HIT has focused upon physician practices and general acute care hospitals; and has largely ignored other organization types such as hospitals providing advanced specialty care (Yeager et al., 2014). Exploring the relationship between market factors and HIT adoption in cancer hospitals may be helpful in understanding how to influence adoption of a technology linked to improvements in care.

The purpose of this study is to examine the relationship between environmental market characteristics and the adoption of HIT among cancer-accredited hospitals. In doing so, we extend what we know from the existing evidence of general, acute care hospitals to a subset of specialty hospitals. Drawing from a nationally representative sample of US hospitals, we first stratify these hospitals into academic cancer hospitals and community cancer hospitals accredited by the Commission on Cancer. We then examine the association between environmental market factors and the adoption of EHRs within their institutions.

This study has implications for hospital chief information officers and chief executive officers within cancer centers who are responsible for managing the adoption of technologies within their organization. While no EHR requirements currently exist for CoC-accredited hospitals, accreditation requires that hospitals document certain criteria in either electronic or paper medical records. Due to the complexity of cancer care, EHR systems may be a necessary investment to improve the quality of care, as well as achieve or maintain accreditation in providing cancer care by organizations such as the Commission on Cancer. Given that these hospitals have to adhere to more stringent quality metrics than general, acute care hospitals; EHR use among cancer hospitals provides a means to improve care coordination (Cipriano et al., 2013) and help facilitate the efficient management of a wider range of services which these specialty hospitals are required to provide. Current evidence on environmental market factors that influence EHR adoption may not be sufficient to make an appropriate decision as no studies currently exist that target specialty hospitals, such as cancer. A greater understanding of the environment's relationship to EHR adoption that is specific to these cancer hospitals will help stakeholders in these institutions make informed strategic decisions about IT investments guided by their facilities' respective environmental characteristics.

Theory

Market environments have a major impact on organizations and often serve as a medium for the resources organizations need to thrive. Thus, the environment is responsible for making resources available to organizations, while at the same time potentially serving as an obstacle to accessing them (Aldrich, 1979). If organizations are to remain viable, they have to learn to adapt to their surroundings (Duncan, 1972) which makes understanding the environment critical. However, for managers developing strategies, the environment tends to also be a source of uncertainty, particularly regarding the availability of resources. Duncan (1972) defined environmental uncertainty as: 1) the lack of information regarding the environmental factors associated with a given decision-making situation, 2) not knowing the outcome of a specific decision in terms of how much the organization would lose if the decision were incorrect, and 3) inability to assign probabilities with any degree of confidence with regard to how environmental factors are going to affect the success or failure of the decision unit in performing its function. Uncertainty is considered an intermediate variable between the environment and organizational processes, structures, and performance (Huber, O'Connell, & Cummings, 1975). Thus, decision makers are prompted to make decisions to reduce this uncertainty and secure the resources needed to remain viable.

Resource Dependence Theory

This study used the Resource Dependence Theory (RDT) to understand how the environment influences hospitals' investments in HIT. RDT was introduced by Pfeffer and Salancik (1978) who assert that "The key to organizational survival is the ability to acquire and maintain resources (p. 2). According to Pfeffer and Salancik (1978), organizations make decisions in order to reduce their uncertainty and their environmental dependence by securing resources. Since its inception, RDT has been used to understand the external environment's influence on organizational behaviors (Hillman, Withers, & Collins, 2009) with a recent review and meta-analysis synthesizing the RDT literature providing support that the theory can be used to explain organizational action (Drees & Heugens, 2013).

Importantly, the RDT has evolved and expanded as it pertains to the health care management literature. Major advances in the theory include more of an emphasis on the information uncertainty principle which is based on the premise that scarce resource availability or uncertainty about the environment motivates managers to act in ways to secure resources and to reduce their uncertainty. The nexus of RDT and the information uncertainty principle led to the development of three constructs used to conceptualize the market environment; namely:

munificence, complexity and *dynamism* (Dess & Beard, 1984). Although a recent review shows that increased attention has been given to the use of RDT and the information uncertainty principle among health care organizations (Yeager et al., 2014), these studies have been limited to general hospitals, nursing homes, and medical practices. No studies have been conducted using other health care settings, for example, specialty hospitals. Below, we describe the aforementioned environmental factors pertaining to resources and uncertainty and discuss ways they may be associated with the adoption of HIT in cancer centers.

Munificence

Munificence represents the amount of resources in the environment that are available to the organization (Starbuck, 1976). The level of resources can be characterized as rich or lean (Aldrich, 1979) and has been found to influence organizational strategy and decision making. For example, early research found that hospitals located in rich environments were positively associated with innovativeness when it comes to adopting imaging technology (Nystrom, Ramamurthy, & Wilson, 2002). In addition, hospitals that adopted technological innovations in rich environments led to increased organizational performance (Irwin, Hoffman, & Geiger, 1998). This conclusion suggests that cancer hospitals that are located in rich resource environments may be more likely to adopt resource-intensive technologies. The literature also suggests that organizations in rich resource environments have greater ability to manage innovations (Smith, Busi, Ball, & Van Der Meer, 2008). As a result, cancer hospitals located in rich environments may be more likely to successfully implement the adoption of new technologies. More recent literature reports that hospitals located in rich environments were associated with being more likely to pursue more resource-intensive HIT management strategies

(Menachemi et al., 2011). Given that accredited cancer centers have to adhere to more stringent quality metrics, cancer centers in markets with more resources available may be more likely to adopt technologies in hopes of improving quality and performance. Thus, we hypothesize:

> *Hypothesis 1:* Cancer centers located in relatively munificent environments will be more likely to adopt EHRs.

Complexity

The construct of complexity pertains to uncertainty in the environment and refers to the heterogeneity and concentration of environmental factors (Aldrich, 1979; Dess & Beard, 1984). In essence, it refers to the intricacy of the environment and the number of different aspects of differentiation that need to be taken into consideration when making a strategic decision. Decision makers in more complex environments experience greater uncertainty compared to those operating in simple environments (Duncan, 1972) due to the presence of more factors they have to consider when making a strategic decision (e.g., adopting EHRs). Within the health care organization literature, complexity is often operationalized as competition within the environment. As a result, when competition increases for cancer centers, this translates into more factors needing to be considered when choosing to pursue strategic efforts such as EHR adoption. Given this increase in uncertainty, it may result in a delayed EHR adoption among hospitals providing cancer care in these environments. In addition, Menachemi and colleagues (2012) found that variables representing increased complexity within the environment such as whether a state was experiencing a malpractice crisis were less likely to adopt HIT.

Hypothesis 2: Cancer centers located in more complex environments will be less likely to adopt EHRs.

Dynamism

Dynamism is another construct that operationalizes uncertainty in the environment and has major influences on decision making. Dynamism represents the level of instability or turbulence in an organization's competitive environment (Child, 1972; Porter, 1980) and requires an organization to achieve harmony between this competitive environment and its internal structure. The success of an organization will depend on its ability to make strategic decisions that are appropriate to deal with relevant environmental factors; however, as environmental dynamism increases, this reduces the ability of decision makers to assess the present and future state of the environment. In addition, this makes it difficult to understand the potential impact of a strategic decision (Aldrich, 1979; Terreberry, 1968) such as the adoption of HIT. For example, if an environment is stable, an organization can develop structured routines in how they utilize available resources because there is little uncertainty allowing decision makers to make more informed strategic decisions. Previous research has conceptualized dynamism by rates of change in variables, such as poverty, within the population. For example, Menachemi et al. (2012) found markets that reported changes in poverty levels which increased uncertainty were less likely to adopt HIT. We therefore assume that cancer centers will be influenced by the level of dynamism in the environment and hypothesize the following:

Hypothesis 3: Cancer centers located in more dynamic environments will be less likely to adopt EHRs.

Methods

Data Source and Study Sample

This study uses a cross-sectional design to analyze the relationship between various environmental market factors and EHR adoption among CoC-accredited hospitals and hospitals that were not CoC-accredited. Hospitals providing cancer care were defined by the Commission on Cancer (CoC) which designates institutions on their ability to provide a wide range of oncologic services to patients. In addition, by including hospitals that were not CoC-accredited and stratifying hospitals by accreditation status, we will have a better understanding of how these market factors affect CoC-accredited and other hospitals differently. Furthermore, CoC-accredited hospitals will be stratified into 2 categories: 1) Academic CoC Hospitals, and 2) Community-based CoC Hospitals. By disaggregating these cancer centers, we will be able to understand if environmental market factors differ in their influence on the adoption of EHRs for different categories of CoC-accreditation that may be masked if these hospitals were considered as one homogenous group.

Secondary data from the American Hospital Association (AHA) Annual Survey was used in addition to the AHA Health IT Supplement and the Area Health Resource File (AHRF). The AHA Annual Survey collects hospital data and characteristics from all hospitals in the US annually. In addition, the AHA Health IT Supplement is a companion to the Annual Survey which tracks the adoption and use of EHRs. Lastly, the AHRF is a comprehensive database which contains information related to health resources and socioeconomic variables for each county in the US that may influence health care.

Dependent Variables

For this study, the following binary dependent variables were used to examine EHR adoption: 1) at least a Basic EHR vs less than a Basic EHR or no EHR, and 2) a comprehensive EHR vs all others. These dependent variables are adapted from definitions used in previous research (Jha et al., 2009).

Specifically, a hospital was classified as having a ***basic EHR*** if it reported having a specific set of ten clinical functions deployed in at least one hospital unit. Six of the ten functions pertain to clinical documentation of 1) demographic characteristics of patients, 2) physicians' notes, 3) nursing assessments, 4) medication lists, 5) discharge summaries, and 6) discharge summaries. Three additional functions pertain to *test and imaging results* of 7) laboratory reports, 8) radiologic reports, and 9) diagnostic-test results. Lastly, one clinical function pertains to 10) *computerized provider-order entry* for medications.

A hospital was classified as having a comprehensive EHR if it reported having a specific set of twenty-four clinical functions deployed in all hospital units. These clinical functions include all ten functions required for a basic EHR, in addition to the following fourteen clinical functions. Comprehensive EHRs are also require *clinical documentation* for 11) advanced directives. Three additional functions pertain to *test and imaging results* for 12) radiologic images, 13) diagnostic-test images, 14) consultant reports. Four additional functions pertain to *computerized provider-order entry* for 15) laboratory tests, 16) radiologic tests, 17) consultation requests, and 18) nursing orders. Lastly, six *clinical functions decision support* for 19) clinical guidelines, 20) clinical reminders, 21) drug-allergy alerts, 22) drug-drug interaction alerts, 23) drug-laboratory interaction alerts, and 24) drug-dose support.

Independent Variables

Independent variables were identified representing the three aforementioned dimensions of the environment. These variables were acquired from the AHA Annual Survey and the AHRF, and the National Cancer Institute's (NCI) State Cancer Profiles. When possible, these variables were measured two years prior to account for any lagged influence on EHR adoption. All market environment variables were measured at the county level as the National Cancer Institute (NCI) estimates that approximately 85% of cancer patients are treated at hospitals located in, or near, their communities (NCI, 2014). A summary of each construct, its respective variables, how each variable was operationalized, and its data source can be found in Table 1.

Environmental munificence. We operationalized munificence using variables representing sources of resources for hospitals providing cancer care. These county-level variables include the following: incident cases of cancer (measured as the average cancer incidence between the years 2007-2012), persons 65 years of age and older in 2010, per capita income for 2010, and geographical location of the hospital (rural or urban area). NCI state cancer profiles were used to obtain incident cases of cancer in the county where the hospital is located representing the amount of potential cancer patients for the hospital. This variable is measured as the average for the previous 5 years (i.e., 2007-2012). In addition, there are approximately 14 million Americans with a history of cancer alive today with 61 percent of them being aged 65 or older (Valdivieso, Kujawa, Jones, & Baker, 2012) making them an essential resource for cancer hospitals. Therefore, we account for the population of persons within the county who are 65 years of age or older. In addition, we captured community income level using the average per capita income for the county in 2009 where the hospital is located, in addition to identifying whether the hospital lies in a rural or urban area which is a useful proxy to represent the availability of resources needed to effectively adopt and implement HIT. Lastly, the percentage of the population living below the poverty level in 2009 was accounted for in each county.

Environmental dynamism. Constructs used to represent dynamism were chosen which bring instability or turbulence to hospitals providing cancer care such as changes in population size and the change in the percentage of the population living below the poverty level between the years 2007 to 2011. Population size has been found to be associated with cancer screening and stage of diagnosis (Olson et al., 2012), while locations with higher poverty rates are associated with lower incidence and higher mortality from cancer (Boscoe et al., 2014). A location's poverty level has also been found to influence different elements of cancer care including cancer screening and survival (Schootman, Jeffe, Baker, & Walker, 2006; Schootman, Jeffe, Lian, Gillanders, & Aft, 2009). Lastly, we took into consideration county-level changes in the burden of cancer and its influence on cancer centers. NCI state cancer profiles were used to obtain changes in cancer incidence and mortality between the years 2007 and 2011 (the most recent data available) for each hospital's respective county.

Environmental complexity. In the health care organization literature, complexity is often operationalized as competition within the environment with one of the more common measurements being the Herfindahl-Hirschman Index (HHI). HHI is represented by a range from 0 to 1, where 1 represents a monopoly. Conversely, lower numbers represent more competition in an area. For the purposes of this paper, we calculated HHI in two distinct ways. In our primary models for CoC-accredited hospitals, competition among CoC-accredited hospitals was calculated to identify markets with more than one CoC-accredited hospital. If only one CoC-accredited hospital is located in a market, the HHI value is 1 by default. As we separately analyze hospitals that are not CoC-accredited, we also calculate HHI for all hospitals in a given market regardless of CoC-accreditation to measure the facilities within a these hospital's market. In addition, previous literature has taken into account the influence of managed care penetration within the market environment on health care organization strategy (Menachemi et al., 2012; Weech-Maldonado, Qaseem, & Mkanta, 2009). In addition, HMO penetration reduces hospital efficiency (Hsieh, Clement, & Bazzoli, 2010). Given the high costs associated with cancer care, managed care penetration has been identified as a major change in the business operations for cancer centers (McGivney & Mullen, 2005). While proponents of managed care plans consider it essential in controlling cost and improving quality of care, they also reduce the flexibility of spending and increase administrative burden. We operationalized environmental complexity as Medicare Advantage managed care penetration using the AHRF.

Statistical Analysis

Descriptive statistics were used to examine the distribution of hospital characteristics for CoC-accredited hospitals, as well as the proportion of hospitals with basic and comprehensive EHRs. We used chi-square analyses and analysis of variance to determine bivariate differences in the adoption of EHRs and environmental market variables. Next, logistic regression models were used to examine the association between EHR adoption and each of the environmental measures controlling for hospital characteristics. The dependent variable in each of our regression models was a binary variable measuring the existence of either: 1) at least a basic EHR [i.e., having either a basic EHR or comprehensive EHR] compared to less than a basic EHR or no EHR; or 2) the existence of a comprehensive EHR vs. all other. Control variables included hospital size (defined by the number of hospital beds), tax status, system affiliation, Medicare and Medicaid patient load. The reported analyses measure environmental market variables at the county level. To test the sensitivity of our results, we also conducted our analyses using other geographic variables including Core Based Statistical Area (CBSA) codes and the findings did not differ significantly from what we present herein. Lastly, we clustered standard errors within each county to adjust for the non-independence of observations. The data were analyzed using the Stata statistical software (version 13.1; StataCorp, College Station, TX). This study was deemed non-human subjects research by the Institutional Review Board of the University of Alabama at Birmingham.

Results

A total of 2,670 hospitals made up our current sample with 141 (0.05%) being academic-based CoC-accredited hospitals and 562 (21%) being community-based CoC-accredited hospitals. Organizational characteristics of community-based and academic-based CoC-accredited hospitals, and other hospitals can be found in Table 2. Academic CoC-accredited hospitals are more likely to be larger (72.3% vs 16.0%, p<0.001), located in urban areas (99.3% vs 81.7%, p<0.001), system affiliated (66.7% vs 60.5%, p<0.001), government (23.4% vs. 11.4%, p<0.001) hospitals, and major teaching hospitals (79.4% vs 3.4%, p<0.001) than community-based CoC-accredited hospitals. Conversely, CoC-accredited hospitals were less likely to be for-profit hospitals (2.8% vs. 6.4%, p<0.001) when compared to community-based CoC-accredited hospitals.

In bivariate analysis, several environmental market variables were associated with the adoption of comprehensive EHRs among academic-based and community-based CoC-accredited hospitals (see Table 3). Beginning with munificence, academic CoC accredited hospitals located in areas that were urban (93.8% vs. 80.5%, p=0.024) were more likely to adopt comprehensive EHRs while there was no difference among academic-based CoC accredited hospitals. No bivariate differences exist with respect to complexity and dynamism.

In the multivariable regression analysis that controlled for hospital characteristics and environmental market factors, several market variables were associated with EHR adoption among CoC-accredited hospitals and hospitals that were not CoC-accredited. We found mixed support for Hypothesis 1 which states that cancer centers located in relatively munificent environments (i.e., environments with an abundance of resources) will be more likely to adopt EHRs (see Table 4). Community CoC-accredited hospitals in areas with higher incidence of cancer (OR=0.99; CI [0.99-1.00]; p=0.020) and a higher percentage of individuals aged 65 and older (OR=0.99; CI [0.99-1.00]; p=0.001) were less likely to have at least a basic EHR. In addition, urban location was associated with the adoption of comprehensive EHRs among community-based CoC hospitals (OR=3.07; CI [0.89-10.61]; p=0.076). No measures of munificence influenced the adoption of basic EHRs among academic CoC hospitals.

We found support for hypothesis 2 which theorized that cancer centers located in more complex environments (measured by the Herfindahl-Hirschman Index and Medicare Managed Care penetration) will be less likely to adopt EHRs. More specifically, community-based CoC-accredited hospitals that were located in areas with higher HHI index (representing less competition with other cancer centers) were less likely to adopt at least a basic EHRs (OR=0.33; CI [0.19-0.96]; p=0.005). In addition, Medicare Managed Care penetration was associated with the increased adoption of comprehensive EHRs among community based CoC-accredited hospitals (OR=1.02; CI [1.00-1.05]; p=0.070).

With respect to community cancer centers, we found no support for hypothesis 3 which theorized that cancer centers located in more dynamic environments (measured by the change in population size, poverty level, incidence rates, and mortality rates for the time period of 2007 to 2011) will be less likely to adopt EHRs. For academic cancer centers, changes in population were associated with EHR adoption. As the size of the population increases, academic cancer centers were less likely to adopt a comprehensive EHR (OR=0.99; CI [0.99-1.00]; p=0.070).

For hospitals that were not CoC-accredited, we found that when it comes to munificence, hospitals located in areas that were urban (OR=1.64; CI [1.04-2.59]; p=0.031) and in areas with a higher percentage of individuals aged 65 and older (OR=1.01; CI [1.00-1.01]; p=0.010) were more likely to adopt comprehensive EHRs. Conversely, those located in areas with increased incidence rates of cancer were less likely to adopt comprehensive EHRs (OR=0.99; CI [0.99-1.00]; p=0.031). In addition, hospitals that were not CoC-accredited and located in areas with a higher percentage of individuals living below the poverty level were less likely to adopt at least a basic EHR (OR=0.97; CI [0.95-1.00]; p=0.088). With respect to the adoption of at least a basic EHR, hospitals that were not CoC-accredited and located in areas with more Medicare Advantage/Managed Care penetration (OR=1.01; CI [1.00-1.02]; p=0.004) were more likely to adopt. We found no relationships when it comes to EHR adoption for other hospitals located in dynamic environments.

Discussion

HIT has been cited as the foundation for an improved cancer care system as its adoption and use among cancer hospitals ensures the effective coordination, management, and continuation of care for patients. Given the complexity of cancer care, cancer hospitals will benefit from the clinical functions such as clinical decision support systems needed throughout the course of diagnosis and treatment. These clinical functions which are identified as vital to the provision of cancer care (Levit et al., 2013) are typically available in more comprehensive EHRs. While the Institute of Medicine acknowledges the use of HIT systems as one of the six components to improve the quality of cancer care (Levit et al., 2013), it also describes the adoption of HIT among cancer centers as "…the exception and not the rule" (p. xiv). Little attention has been given to the adoption of HIT among cancer centers, and to our knowledge, this is the first study to examine market characteristics' association with EHR adoption among these institutions. Ultimately, we found that the environment may play a role in the adoption of comprehensive EHRs among CoC-accredited hospitals, but not necessarily in ways hypothesized by the RDT. In addition, we found that market factors within the environment may differentially affect EHR adoption for academic-based and community-based cancer hospitals.

Based on our sample of CoC-accredited hospitals, we found mixed support for Hypothesis 1 which states that cancer centers located in relatively munificent environments will be more likely to adopt EHRs. In fact, we found the opposite, whereby Community-based CoC-accredited hospitals were less likely to adopt at least a basic EHR when located in areas with higher incidence of cancer or higher percentage of individuals aged 65 and older. One potential explanation may result from the upward trend in the costs of care associated with cancer which are found to be increasing over time (Mariotto, Robin Yabroff, Shao, Feuer, & Brown, 2011). These trends in the costs of cancer care have a major influence on hospitals providing cancer care that must be taken into consideration when setting priorities and allocating resources (Warren et al., 2008). For hospitals located in areas with an increased incidence of cancer, this planning may result in more resources being devoted to costs related to the provision of services to cancer patients leaving fewer available resources to devote to IT investments. This may also be true for hospitals that are not CoC-accredited, for which we also found an inverse association between the incidence rate of cancer and comprehensive EHR adoption.

On the other hand, CoC-accredited hospitals located in urban locations, also a measure of munificence, were observed to have higher levels of adoption of comprehensive EHR adoption, as hypothesized. This finding is consistent with the previous literature on EHR adoption which states that hospitals located in urban areas are more likely to adopt EHRs (DesRoches et al., 2013; Jha et al., 2011). Similarly, hospitals that were not CoC-accredited were also more likely to adopt comprehensive EHRs if they were located in urban areas.

Hypothesis 2 states that cancer centers located in more complex environments will be less likely to adopt EHRs. Again, we found mixed support for this hypothesis measuring complexity with market competition (measured by HHI) and Medicare Advantage/Managed Care penetration. With respect to market competition, we found that community-based CoC hospitals located in areas with less competition were less likely to adopt at least a basic EHR. While less competition may result in fewer factors that affect the strategic decision of adopting EHRs, the lack of competition may also remove the pressure to adopt EHRs that may be present in an environment where hospitals have to compete with other cancer centers. In the absence of this pressure, more resources may be devoted to the provision of services for the cancer center's catchment area. In addition, we unexpectedly found that Medicare Advantage/Managed Care penetration was positively associated with comprehensive EHR adoption for CoC-accredited hospitals. This finding is also consistent with previous literature which found that HMO penetration led to higher EMR adoption among medical practices (Menachemi et al., 2012). While managed care options are found to create major changes in cancer hospital business operations ultimately reducing their spending flexibility, this creates an additional administrative burden which in turn creates a need for EHR systems. For CoC-accredited hospitals, an increase in Medicare Advantage/Managed Care penetration may also provide adults with increased access to needed cancer prevention and treatment health services. There is evidence that Medicare-aged cancer patients have higher utilization rates before a cancer diagnosis (Hornbrook et al., 2013). This increased utilization of these services may require comprehensive EHRs to manage and coordinate care for this population's increased patient load. This increase in adoption of comprehensive EHRs was also found for hospitals that were not CoC-accredited.

With respect to dynamism, we found that academic CoC-accredited hospitals were less likely to adopt comprehensive EHRs if they were located in areas with increased population change. Dynamism in a previous study was found to be consistently linked to EHR adoption (Menachemi et al., 2012); however, dynamism was not as consistently supported for CoC-accredited hospitals or hospitals that are not CoC-accredited in the current study. Lack of significant findings for community-based CoC hospitals may be a result of these hospitals being more adaptable to changes within the communities which they cater to. Future research should explore other potential causes of fluctuations relevant to hospitals providing cancer care, such as changes in costs of cancer care, and how they may influence EHR adoption.

Limitations

Our study has several limitations worth noting. Given that no other literature has looked specifically at munificence, complexity, and dynamism among cancer hospitals; one limitation lies in the selection of measures to operationalize each construct as we have little guidance in measuring these constructs among cancer hospitals. In addition, this study uses a cross-sectional research design and is therefore unable to identify causal relationships. As such, these findings can only be interpreted as associations. Lastly, hospitals eligible for the meaningful use incentive program may have been more likely to adopt EHRs. A limitation in our analysis is that we are not able to distinguish which cancer hospitals are eligible for meaningful use.

Practice Implications

For managers within cancer hospitals, the question is what environmental conditions are conducive to the adoption and implementation of EHRs. While EHRs play an important role in providing quality cancer care (Levit et al., 2013), decisions about EHR adoption are challenging given competing priorities for available resources. To inform these adoption decisions, we provide evidence on the environmental market factors that are associated with adoption of EHRs for both academic-based and community-based cancer hospitals.

A greater understanding of the environment's relationship to EHR adoption in cancer hospitals is vital for managers tasked with making informed strategic decisions about IT investments. By disaggregating cancer hospitals into community cancer centers and academic cancer centers, we were able to uncover unique differences that may help inform EHR adoption decisions by identifying favorable conditions for acquisition. If the market conditions in which a cancer hospital resides are not favorable for them to pursue EHR adoption, it may be necessary to find additional ways to accomplish this goal. For example, hospitals located in unfavorable market conditions may consider identifying other organizations within or outside their market that can partner with it to negotiate more favorably with EHR vendors. Likewise, standalone cancer hospitals can consider similar purchasing alliances that can also exchange human resources and EHR-related adoption and implementation expertise.

This study fills a gap in prior empirical work that has been limited to general, acute care hospitals and has largely overlooked specialty hospitals. Even with HITECH incentives, EHR adoptions remains a challenge from initial investment to implementation. Especially for managers who are faced with decisions of how to allocate resources in a climate where the costs of providing care are steadily increasing. Additional investments, such as that of an EHR, may be less of a priority for hospitals that are not located in markets with ideal conditions for successful implementation to ensure return on investment. More research is needed to further develop our understanding of these market conditions and adequately measure constructs of munificence, complexity, and dynamism for specialty hospitals such as cancer hospitals.

Conclusions

While the use of HIT applications has been widely cited as a means to improve cancer care (Clauser et al., 2011; Hesse et al., 2010; Levit et al., 2013), the adoption of HIT among hospitals providing cancer care is the mechanism through which any potential benefits are to be realized. While our hypotheses were not necessarily supported, the findings of this research highlight important ways in which the environment may be linked to the adoption of EHRs. These results may be useful to decision makers within hospitals providing cancer care, as well as policymakers who should take into consideration market factors and their influence on policies designed to improve EHR adoption and the quality of cancer care provided by CoC-accredited hospitals.

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Table 1. Variables used in the current study and their respective data sources

Construct	**Measurement**	**Data source**
Categorical dependent variable		
EHR adoption	Less than basic EHR	AHA HIT Supplement (2012)
	Basic EHR	
	Comprehensive EHR	
Independent Variables		
Environmental munificence	Cancer incidence in county	NCI state cancer profiles
	Persons aged 65+	AHRF (2009)
	Per capita income	AHRF (2009)
	Urban location	AHRF (2009)
	Poverty level	AHRF (2009)
Environmental dynamism	Changes in population size	AHRF (2009)
	Changes in cancer mortality	NCI state cancer profiles
Environmental complexity	Market concentration measured by HHI	AHA (2009)
	Medicare Advantage managed care penetration	AHA (2009)
Control variables	Hospital size	AHA (2009)
	US region	AHRF (2009)
	Tax status	AHA (2009)
	System affiliation	AHA (2009)
	Medicare patient load	AHA (2009)
	Medicaid patient load	AHA (2009)

Table 2. Descriptive statistics of cancer hospitals and other hospitals (2012)

	Academic CoC-Hospitals (n=141)	**Community CoC-Hospitals (n=562)**	**Other Hospitals (n=1,967)**	
	n (%)		**n (%)**	**p-value**
EHR Adoption				
Less than a Basic EHR	61 (43.3)	382 (68.0)	1,468 (74.6)	
At least a Basic EHR	80 (56.7)	180 (32.0)	499 (25.4)	
Comprehensive EHR	29 (20.6)	48 (8.5)	162 (8.2)	
Hospital Size (# staffed beds)				
Small (<100 beds)	1 (0.7)	55 (9.8)	1,184 (60.2)	<0.001
Medium (100-399 beds)	38 (27.0)	417 (74.2)	654 (33.3)	<0.001
Large (400+ beds)	102 (72.3)	90 (16.0)	129 (6.6)	<0.001
Hospital Type				
For-profit	4 (2.8)	36 (6.4)	246 (12.5)	<0.001
Government	97 (23.4)	64 (11.4)	573 (29.1)	<0.001
Urban				
Yes	140 (99.3)	459 (81.7)	903 (45.9)	<0.001
No	1 (0.7)	103 (18.3)	1,064 (54.1)	
US Region				
Midwest	39 (27.7)	185 (32.9)	744 (37.8)	0.010
Northeast	39 (27.7)	110 (19.6)	231 (11.7)	<0.001
South	44 (31.2)	188 (33.5)	630 (32.0)	0.785
West	19 (13.5)	78 (13.9)	336 (17.1)	0.127
System-affiliated				
Yes	94 (66.7)	340 (60.5)	970 (49.3)	<0.001
No	47 (33.3)	222 (39.5)	997 (50.7)	
Major Teaching				
Yes	112 (79.4)	19 (3.4)	88 (4.5)	<0.001
No	29 (20.6)	543 (96.6)	1,871 (95.5)	
	x (SD)		*x* (SD)	
Medicare Patient Load	37.3 (10.2)	47.8 (8.8)	51.4 (15.7)	<0.001
Medicaid Patient Load	22.6 (10.9)	17.5 (8.4)	17.0 (11.06)	<0.001

Table 3. Bivariate associations between comprehensive EHR adoption and environmental market factors among CoC-accredited hospitals

	Comprehensive EHR Adoption among Academic CoC Hospitals			**Comprehensive EHR Adoption among Community CoC Hospitals**		
	Yes (n=29)	**No (n=112)**		**Yes (n=48)**	**No (n=514)**	
	n (%)	**n (%)**	**p-value**	**n (%)**	**n (%)**	**p-value**
Munificence						
Urban Location	29 (100.0)	111 (99.1)	0.61	45 (93.8)	414 (80.5)	0.024
	***x* (SD)**	***x* (SD)**	**p-value**	***x* (SD)**	***x* (SD)**	**p-value**
Munificence cont.						
Incidence Rate	741.3 (4.56)	476. 06 (3.11)	0.47	463.22 (6.39)	471.13 (1.55)	0.14
% Population 65+	13.40 (0.33)	13.96 (0.13)				0.15
Per Capita Income	$44,501.97 (1354.97)	$45,928.97 (1,444.24)	0.62	$40,597.19 (1,288.11)	$39,962.84 (423.21)	0.66
Poverty Level	14.7 (0.63)	15.6 (0.22)	0.35	12.7 (0.70)	13.8 (0.23	0. 15
Complexity						
HHI	0.43 (0.06)	0.48 (0.03)	0.44	0.67 (0.05)	0.70 (0.01)	0.57
Medicare Penetration	28.5 (2.58)	26.3 (1.19)	0.42	26.0 (2.15)	21.2 (0.57	0.018
Dynamism						
Change in population size	8,764.35 (10,311)	27,103.57 (5,610.62)	0.14	15,127.65 (5,219.62)	11,674.80 (1,385.83)	0.47
Death Change	-1.35 (0.12)	-1.53 (0.06)	0.21	-1.34 (0.08)	-1.29 (0.32)	0.63

Table 4. Association between environmental market factors and the adoption of at least a basic EHR and comprehensive EHRs

	At least a Basic EHR[a]			**Comprehensive EHR[b]**		
	Academic CoC-Hospitals (n=140)	**Community CoC- Hospitals (n=558)**	**Other Hospitals (n=1,904)**	**Academic CoC-Hospitals (n=136)**	**Community CoC- Hospitals (n=558)**	**Other Hospital (n=1,904)**
	n (%)		**n (%)**	**n (%)**		**n (%)**
Munificence cont.						
Incidence Rate	0.99	0.99**	1.00	0.99	1.00	0.99**
% Population 65+	1.00	0.99***	1.00	1.00	1.00	1.00**
Per Capita Income	1.00	1.00	1.00	1.00	1.00	1.00
Poverty Level	1.03	0.98	0.97*	0.93	0.98	0.99
Urban Location		1.10	0.97		3.07*	1.64**
Complexity						
HHI	0.47	0.33***	1.39	0.20	0.81	1.41
Medicare Penetration	1.02	1.00	1.01***	1.02	1.02*	1.00
Dynamism						
Population Change	1.00	1.00	1.00	0.99*	1.00	1.00
Death Change	1.46	0.94	1.03	1.22	0.86	1.05
Hospital Size						
Small (<100 staffed beds)		Ref	Ref		Ref	Ref
Medium (100-399 staffed beds)		0.74	1.30**		0.47*	1.15
Large (400+) staffed beds		1.14	1.21		0.30**	0.96
System-affiliated						
Yes	0.56	1.44*	1.44***	1.24	4.12***	2.11***
No	Ref	Ref	Ref	Ref	Ref	Ref
Major Teaching						
Yes			2.91***			1.78
No			Ref			Ref
For-profit Hospital						
Yes	0.95	0.43*	0.61**		0.15*	0.46**

No	Ref	Ref	Ref		Ref	Ref
Government Hospital						
Yes	0.91	1.31	0.74**	1.24	0.25	0.41***
No	Ref	Ref	Ref	Ref	Ref	Ref
Medicare Patient Load	0.99	1.01	1.00	0.98	0.99	1.00
Medicaid Patient Load	1.02	1.00	1.02***	0.96	1.01	1.00

*p<0.10; **p<0.05; ***p<0.01

[a]The reference category are hospitals with less than a basic or no EHR

[b]The reference category are hospitals with less than a comprehensive EHR (i.e., a basic EHR, less than a basic EHR, or no EHR)