

Market factors and electronic medical record adoption in medical practices

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Abstract:

Background: Previous studies identified individual or practice factors that influence practice-based physicians' electronic medical record (EMR) adoption. Less is known about the market factors that influence physicians' EMR adoption.

Purpose: The aim of this study was to explore the relationship between environmental market characteristics and physicians' EMR adoption.

Methods: The Health Tracking Physician Survey 2008 and Area Resource File (2008) were combined and analyzed. Binary logistic regression was used to examine the relationship between three dimensions of the market environment (munificence, dynamism, and complexity) and EMR adoption controlling for several physician and practice characteristics.

Results: In a nationally representative sample of 4,720 physicians, measures of market dynamism including increases in unemployment, odds ratio (OR) = 0.95, 95% confidence interval (CI) [0.91, 0.99], or poverty rates, OR = 0.93, 95% CI [0.89, 0.96], were negatively associated with EMR adoption. Health maintenance organization penetration, OR = 3.01, 95% CI [1.49, 6.05], another measure of dynamism, was positively associated with EMR adoption. Physicians practicing in areas with a malpractice crisis, OR = 0.82, 95% CI [0.71, 0.94], representing environmental complexity, had lower EMR adoption rates.

Practice Implications: Understanding how market factors relate to practice-based physicians' EMR adoption can assist policymakers to better target limited resources as they work to realize the national goal of universal EMR adoption and meaningful use.

Keywords: health care management | electronic medical records | electronic health records | physician practices

Article:

Over the past decade, researchers have examined the factors associated with electronic medical record (EMR) adoption in physician practices. Several authors, for example, have found that EMR adoption is correlated with physician characteristics such as age (Menachemi & Brooks, 2006), specialty (DesRoches et al., 2008; Simon et al., 2008), years in practice (DesRoches et al., 2008), and level of comfort with computers (Loomis, Ries, Saywell, & Thakker, 2002), as well as practice characteristics such as size (DesRoches et al., 2008; Hing, Burt, & Woodwell, 2007), type of patients treated (Menachemi, Matthews, Ford, & Brooks, 2007), and practice payer mix (Abdolrasulnia et al., 2008). Researchers have also found that financial barriers play a major role in the lagging adoption of EMR by physicians (Agrawal, 2002; Schmitt & Wofford, 2002). In an effort to promote an accelerated EMR adoption rate, the federal Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009 makes available financial incentives to encourage physicians to adopt EMR systems (Blumenthal, 2009).

Strategic management theory (Dess & Beard, 1984; Duncan, 1972) suggests that major organizational initiatives (such as EMR adoption by a medical practice) are designed to align that organization with the changing environment in which it exists. Indeed, the health care literature is filled with empirical studies that link market characteristics to major organizational decisions including establishing new service lines (Weech-Maldonado, Qaseem, & Mkanta, 2009), hospital EMR adoption (Kazley & Ozcan, 2007), and hospital health information technology management strategies (Menachemi, Shin, Ford, & Yu, 2011). Despite the potential role that the market environment plays in EMR adoption decisions in medical practices, little is known about this relationship.

The purpose of this study was to examine how market factors and physicians' EMR adoption rates are related. Despite the growing literature on EMRs, to our knowledge, no study has examined how the external environment is potentially related to the adoption of EMRs by medical practices. Understanding this relationship has both policy and theoretical implications. From a policy perspective, given that the HITECH Act does not directly address environmental factors, understanding the role that market forces play will help federal, state, and local decision makers to more effectively use their resources to promote EMR adoption. In particular, the

Regional Extension Centers that are funded by HITECH to assist physicians at the local level can identify markets within their states that are most amenable to EMR adoption and those that will have the greatest challenges. From a theoretical perspective, this study will test the extent to which resource dependence theory (Pfeffer & Salancik, 2003) and the information uncertainty principle (Duncan, 1972; Thompson, 1967) apply to the physician practice market, which is characterized by a predominance of small businesses made up of solo physicians or small group practices.

Conceptual Framework

Researchers have long argued that the survival of an organization is dependent on its continuous interaction with its environment (Barnard, 1968; Duncan, 1972; Kreiser & Marino, 2002). The environment is conceptualized as a source of resources (Pfeffer & Salancik, 2003; Thompson, 1967) and information (Duncan, 1972) and therefore has an impact on organizational strategies and performance. Two perspectives commonly used to analyze organizations' interactions with their environments are the resource dependence theory and the information uncertainty perspective. The resource dependence theory suggests that an organization does not control all the resources it needs to survive and therefore employs several strategies that aim to reduce its dependence on external resources (Miller, 1987; Pfeffer & Salancik, 2003). The information uncertainty perspective argues that decision makers do not possess all the information needed about their environment to make decisions (Simon, 1961; Dickson & Weaver, 1997; Duncan, 1972; Thompson, 1967). Therefore, decision makers rely mostly on their perceptions regarding the environment rather than on measures of objective reality. Taken together, these theoretical perspectives identify three main dimensions of the environment: munificence, dynamism, and complexity.

Environmental munificence is concerned with the availability and accessibility of environmental resources to organizations (Dess & Beard, 1984; Miller, 1987; Trinh & O'Connor, 2002; Zinn, Proenca, & Rosko, 1997). Environmental dynamism reflects the rate of change in the environment (Dess & Beard, 1984; Ford, Duncan, & Ginter, 2003; Miller, 1987; Tan & Litschert, 1994; Zinn et al., 1997). Lastly, environmental complexity reflects the number of various actors or elements in the environment that should be taken into consideration when making decisions of strategic importance (Dess & Beard, 1984; Hsieh, Clement, & Bazzoli, 2010; Zinn et al., 1997).

Management researchers have employed the resource dependence theory and the information uncertainty perspective to illustrate the relationship between environmental factors and

organizational strategies (Banaszak-Holl, Zinn, & Mor, 1996; Kazley & Ozcan, 2007; Menachemi, Shin, et al., 2011). The remainder of this section will be devoted to the illustration of the potential relationship between selected environmental factors and EMR adoption by physicians.

Munificence

Munificence refers to the abundance and availability of critical resources in the environment (Dess & Beard, 1984; Keats & Hitt, 1988). The availability of resources is important because most major organizational strategies require the availability of human, financial, and other resources that may not be possessed by a given organization. Previous research has shown that organizations that operate in munificent environments are more productive and have higher flexibility in pursuing various strategies (Yasai-Ardekani, 1989). On the contrary, organizations that operate in less munificent environments have to concentrate more energy on securing necessary resources so that they can reduce their dependency from those in the environment that control critical resources (Kreiser & Marino, 2002). For example, it was shown that hospitals that operate in less munificent environments were more likely to pursue a less expensive and less labor-intensive health information technology strategy than were their counterparts that had more financial and human resources (Menachemi, Shin, et al., 2011). On the other hand, nursing homes that operated in more munificent environments, operationalized as receiving higher Medicaid reimbursement, were more likely to pursue an innovative strategy (Weech-Maldonado et al., 2009).

Ultimately, organizations in more munificent areas have more resources available to them as inputs into major organizational decisions. The availability of these resources makes complex strategies more feasible. Electronic medical records represent a complex major initiative for a medical practice because the vendor selection process, implementation process, and system-training stage require extensive external resources. These resources include professional expertise, the availability of financing options, and other services that may not be available in markets characterized as resources depleted. Given that these resources are often cited as barriers to EMR adoption, we hypothesize the following:

Hypothesis 1: Physicians practicing in relatively munificent environments will be more likely to adopt an EMR system.

Dynamism

According to the information uncertainty perspective, individuals do not possess all the information about their environment necessary to make optimal decisions. Therefore, the

decision-making process is guided largely by perceptions about an organization's environment (Keats & Hitt, 1988). The rate of change in the environment (e.g., dynamism) increases the decision makers' level of uncertainty and subsequently impacts their strategic choices. In the context of a decision regarding EMR adoption, environments with a high rate of change may induce the status quo among decision makers. The dynamic nature of some environments increases the anxiety of decision makers, thus delaying major initiatives, especially those that require significant planning. In fact, empirical evidence supports this. In one study, organizations operating in more dynamic environments tended to pursue short-term and less risky strategies (Tan & Litschert, 1994). In another study of companies in the medical X-ray manufacturing industry, the dynamic change introduced as a result of federal regulations resulted in the pursuit of less risky strategies and a decrease in product invention strategies (Birnbaum, 1984). Because the decision to adopt an EMR system by a physician practice represents a major investment of time and money, we expect that major (distracting) fluctuations in the external environment would delay this decision. Thus, we hypothesize the following:

Hypothesis 2: Physicians practicing in environments that are more dynamic will be less likely to adopt an EMR system.

Complexity

Environmental complexity represents the range and quantity of elements that should be taken into consideration by an organization when making strategic choices (Layman & Bamberg, 2005). Therefore, decision makers operating in relatively complex environments will have to account for greater numbers of environmental factors, which will make decision making more onerous. Previous studies have shown that organizations operating in more complex environments will pursue defensive-oriented strategies rather than proactive, future-oriented, and more risky strategic initiatives (Tan & Litschert, 1994). For instance, nursing homes operating in areas with greater regulatory stringency were less likely to pursue innovative strategies such as development of designated units for the provision of specialty care (Banaszak-Holl et al., 1996). Similarly, market complexity is expected to adversely influence the decision to adopt an EHR, in part because complex environments are by definition more difficult to understand. To the extent that complex markets also reallocate decision makers' focus on other issues (e.g., those items causing the market to be characterized as complex), we would expect less time and energy to be devoted to the decision to adopt an EHR. We therefore assume that physician decisions regarding EMR adoption will be influenced by the level of complexity in the environment and hypothesize the following:

Hypothesis 3: Physicians practicing in environments that are more complex will be less likely to adopt an EMR system.

Methods

This study used a cross-sectional design to analyze the relationship between EMR adoption and several environmental factors using secondary data sources. The data were obtained from the 2008 Health Tracking Physician Survey (HTPS), the Area Resource File (ARF), the Dartmouth Atlas, and the American Medical Association (AMA). We extracted the main dependent variable, EMR adoption, and several physician characteristics from the HTPS database. The HTPS data were obtained through a mail survey conducted by the Inter-University Consortium for Political and Social Research (2008). The data reflecting environmental characteristics were extracted from the ARF, which contains various county-level market characteristics from all U.S. states.

The HTPS study sample consists of a nationally representative sample of U.S. physicians. The sample was derived from a list of physicians provided by the AMA. A stratified random sampling method was used for selection of respondents. The survey excluded federal employees, specialists in fields in which the primary focus was not direct patient care, graduates of foreign medical schools who were only temporally licensed to practice in the United States, physicians who had not completed their medical training (resident, interns, and fellows), and physicians who requested the AMA that their names not be released to outsiders. In addition, radiologists, anesthesiologists, and pathologists were excluded from the survey. The final sample consisted of 4,720 physicians. The institutional review board at the university of the primary author approved this analysis.

Dependent Variable

Adoption of EMR was measured by the following survey question: “An electronic medical record (EMR) is a computer-based medical record. Does your main practice use electronic medical records?” Because the purpose of this study was to examine how market forces are related to the strategic decision to adopt an EMR, we considered any medical practice that has begun an implementation process (even if very recently) as “adopters.” Presumably, and consistent with our conceptual framework, if the EMR decision was influenced by market forces, all practices that have implemented an EMR should be classified together. Thus, we categorized all responses indicating that EMR implementation has at least begun (e.g., part electronic and full EMR adoption) into a single category.

Independent Variables

In line with the previous empirical studies, we selected independent variables that represented three dimensions of the environment from the ARF and HTPS (Figure 1). We operationalized

environmental munificence through the following variables: community income level, geographical location of the physician's practice (metro area or not metro area), and supply of physicians (Ginn & Young, 1992; Hsieh et al., 2010; Kazley & Ozcan, 2007; Trinh & O'Connor, 2002). Specifically, community income level was measured as average per capita income. Metro areas were measured because they represent the availability of human resources including information technology professionals and other experts that can assist with an EMR implementation. Lastly, the supply of physicians was captured through both the number of primary care and physician specialist per 1,000 capita.

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Levels of managed care penetration and degree of instability in health services demand were selected to represent environmental dynamism. Both constructs are commonly used by researchers to operationalize dynamism (Kazley & Ozcan, 2007; Weech-Maldonado et al., 2009; Zinn et al., 1997). Previous research has shown that managed care brings instability to an organization's environment by increasing the administrative burden and reducing financial flexibility (Zinn et al., 1997). Furthermore, managed care introduces several changes in the day-to-day operations of physician practices, including risk-sharing payment schemes, constantly updated formularies, and other policies that create dynamic change. In our study, managed care penetration was measured as the percentage of a given county's population that was covered by a health maintenance organization (HMO) and was obtained from the 2008 Dartmouth Atlas (Wennberg, Fisher, Goodman, & Skinner, 2008). The degree of instability in health services demand reflects another aspect of environmental dynamism because it captures the unpredictability in the consumption of health care. In our study, we used changes in unemployment rate, changes in poverty levels, and changes in the population size from 2002 to 2007 representing the 5 years prior to our study period. This information was retrieved from the 2008 ARF.

Two variables were used to represent environmental complexity. The first was a measure obtained from the HTPS measuring physician's perceptions about competition in their market. Competition is frequently used to operationalize complexity because an increase in this variable increases the number of elements that should be taken into consideration when making strategic decisions. The second variable, obtained from the AMA, indicated the presence of a malpractice crisis in each respondent's state. States are classified by the AMA as having a malpractice crisis if a significant proportion of physicians are limiting the scope of services they provide, for example, by no longer performing trauma surgery or delivering newborns (AMA, 2011). We believe that this measure may adequately represent complexity because highly litigious

environments increase the number of factors that need to be considered when making significant organizational decisions, especially among physicians (Studdert, Mello, & Brennan, 2004).

Our analysis used the following control variables: physician's demographic characteristics (gender, ethnicity, and years in practice), professional characteristics (specialty, board certification, and country of medical degree), physician's practice setting (measured as solo or two physicians, groups of three or more, HMO practice, medical school, hospital based, or other), number of hours in direct patient care, and ownership status.

Data Analysis

We used chi-square analysis and analysis of variance, as appropriate, to detect univariate differences in EMR adoption by each of the environmental variables. Next, logistic regression was used to examine the association between the binary dependent measure (EMR adoption) and each of the environmental measures, controlling for the above covariates. All data analyses were conducted in STATA Version 11.0, accounting for the complex survey design including appropriate weighting variables. Furthermore, standard errors were clustered within counties to adjust for the nonindependence of observations that could otherwise bias the results. Statistical significance was considered at the $p < .05$ level.

Results

The HTPS response rate for 2008 was 61.9% and included 4,720 physician observations. Adoption of EMR for the sample was 50.9%. Physician and practice characteristics, as well as average market characteristics, are presented in Table 1. Briefly, physicians were predominately male (73.5%), White (79.4%), and working in a solo or small practice with fewer than three physicians (72.6%). Overall, 89.6% of the respondents indicated being board certified in their practice specialty, and 40.0% of respondents, overall, were primary care physicians (PCPs). A majority of physicians were in metropolitan areas (89.5%), and median per capita income across markets was \$37,362. The mean number of PCPs per 1,000 capita and specialists per 1,000 capita was 0.97 and 1.15, respectively. Lastly, the average HMO penetration rate was 13%, and 27.2% of physicians believed that their practice was in a very competitive area.

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In the univariate analysis, several market variables were associated with EMR adoption among physicians (Table 2). Physicians in metropolitan areas were more likely than their counterparts to have adopted an EMR (51.5% vs. 46.0%; $p = .02$). In addition, physicians with an EMR were

more likely to be in markets with higher PCPs (1.0 vs. 0.94; $p < .001$) and specialists (1.2 vs. 1.1; $p < .001$) per capita. With respect to the measures of dynamism, HMO penetration was higher among physicians with an EMR (13.0% vs. 12.2%; $p = .008$), and changes in both unemployment rates and poverty levels were associated with EMR adoption among physicians (Table 2). Lastly, both measures of environmental complexity were associated with EMR adoption in the univariate analysis. Specifically, physicians in a malpractice crisis state were less likely to have an EMR system (48.3% vs. 53.3%; $p = .001$), and those who perceived their market as very competitive were less likely than others to have adopted an EMR.

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In the multivariable regression analysis controlling for physician and practice characteristics, several market measures were associated with EMR adoption. Namely, none of the variables representing munificence were associated with EMR adoption (Table 3). Therefore, Hypothesis 1 was not supported. However, Hypothesis 2, which stated that physicians who practiced in relatively dynamic environments will be less likely to adopt EMR, was partially supported. Specifically, the variables measuring change in poverty level, odds ratio (OR) = 0.93, 95% confidence interval (CI) [0.89, 0.96], and change in unemployment rates, OR = 0.95, 95% CI [0.91, 0.99], were significantly related to EMR adoption in theoretically supported ways (Table 3). However, contrary to Hypothesis 2, HMO penetration, OR = 3.00, 95% CI [1.49, 6.05], was positively associated with EMR adoption.

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Lastly, Hypothesis 3 was partially supported. This hypothesis tested whether physicians in complex markets were less likely to adopt EMRs. Whereas practice location in a malpractice crisis state was negatively associated with EMR adoption among physicians, OR = 0.82, 95% CI [0.71, 0.94], the perceived level of competition was not related to EMR adoption in the multivariable model.

Discussion

Adoption of EMR among physician practices is a national goal outlined in the HITECH Act. Numerous previous studies have identified physician and practice characteristics associated with EMR adoption among physicians (DesRoches et al., 2008; Hing et al., 2007). However, no studies have examined how market characteristics are associated with EMR adoption in the medical practice setting. This study operationalized various measures of the market environment to examine how munificence, dynamism, and complexity are related to EMR adoption.

The main findings of our study indicate that measures of fluctuations in the market (e.g., dynamism) are the most consistently associated with EMR adoption among physicians. We found that larger increases in unemployment rates and poverty rates were associated with lower EMR adoption, consistent with our hypothesis. This finding is congruent with previous studies of both health care (Birnbaum, 1984; Zinn et al., 1997) and industry (Tan & Litschert, 1994) organizations that found that the uncertainty associated with dynamic conditions delays the decision to pursue expensive, risky, or disruptive strategies. The HITECH Act addresses well-established financial barriers to EMR adoption. However, the impact of this technology may ultimately be attenuated because the Act does not address market factors that may play an important role in the decision to adopt EMRs.

Consistent with previous research, we hypothesized that the uncertainty introduced by increasing HMO penetration would result in lower EMR adoption rates among physicians. Unexpectedly, we found the opposite trend. This finding may be because HMO companies typically introduce reimbursement mechanisms such as capitation (Kerr et al., 1995), risk sharing (Rosenthal, Landon, & Huskamp, 2001), and pay for performance (Petersen, Woodard, Urech, Daw, & Sookanan, 2006) that reward physicians for reducing unnecessary utilization, improving quality, and increasing efficiency. Perhaps, physicians view the adoption of EMR technology as a strategy to better manage information about their practices in an effort to be better able to successfully contract with HMOs. It is also possible that physicians view EMR use as a way to increase efficiency through the reduction of paper and duplication of services. Overall, this finding may augur well for those promoting the accountable care organization, which has many features in common with HMOs, as a means of improving care quality and controlling costs (Shields, Patel, Manning, & Sacks, 2011).

Being in a market with higher complexity makes decision making more onerous and time-consuming for major strategic initiatives. We operationalized complexity as being in a state with a malpractice crisis, and this variable was negatively associated with EMR adoption as hypothesized. Ironically, EMR use can facilitate improved legal and regulatory compliance by more securely and confidentially storing patient records (Agrawal, 2002) and can increase the legibility and completeness of patient records while increasing adherence to clinical guidelines (Virapongse et al., 2008). Researchers have also found that physicians in Massachusetts using an EMR were less likely to have paid malpractice claims against them (Virapongse et al., 2008). Taken together, our findings suggest that those who may benefit most from EMR adoption are also the least likely to invest in this technology. This raises an important avenue for future research that can examine how physicians in litigious environments make decisions regarding EMR adoption.

Contrary to our hypotheses regarding the relationship between munificence and EMR adoption, none of the variables measuring resource abundance in the market were related to our dependent variable. A couple of reasons may explain this finding. First, it is possible that the variables we used to measure munificence failed to appropriately operationalize the multidimensional nature

of this construct. Nevertheless, we used variables commonly appearing in the literature (Kreiser & Marino, 2002; Menachemi, Shin, et al., 2011; Weech-Maldonado et al., 2009). On the other hand, it is possible that, unlike in the study of hospitals (Kazley & Ozcan, 2007), munificence as operationalized in both studies does not capture resources that are critical in relation to EMR adoption in the medical practice setting.

Lastly, all of the control variables predicting EMR adoption yielded results consistent with expectations. We found that years in practice, a proxy for age, and PCPs were negatively associated with EMR adoption, a finding that echoes previous studies (DesRoches et al., 2008; Simon et al., 2008). Similarly, previous studies have found that board certification or practice type was associated with EMR adoption (DesRoches et al., 2008; Hing et al., 2007; Menachemi, Powers, & Brooks, 2011). Our study also found that international medical graduates were less likely to adopt EMRs. To our knowledge, no previous study has examined the relationship between international medical graduates and EMR utilization. Given that international graduates make up a significant proportion of our medical workforce, especially in rural areas (Akl, Mustafa, Bdair, & Schu`nemann, 2007), future research should examine why these physicians may be less likely to adopt this technology.

Our study has several limitations worth discussing. First, organizational environment is a multidimensional construct that is difficult to operationalize. Despite being guided by previous literature, we recognize the challenge in selecting measures that capture all the dimensions effectively. Second, our study design is cross-sectional in nature. As a result, the relationships identified could only be interpreted as associations. Future research should employ longitudinal designs to better understand the potential causal nature of market factors on EMR adoption. Third, we recognize that data availability forces us to measure environmental characteristics at the county level, which may not be the only or the most appropriate market unit of analysis applicable to physician practices.

Given the promise of EMRs to impact the quality and efficiency of care, the HITECH Act aims to provide incentives for increasing EMR use in physician practices. Our results identify important environmental characteristics, such as complexity and uncertainty, which may influence the likelihood of EMR use in physician practices. Because many smaller physician practices may not have the expertise or resources to participate in formal strategic planning, the results of this study should be especially valuable for managers of medical practices who make decisions about EMR adoption in light of the new federal incentives. In addition, given our findings, managers in medical practices will have insights about strategies of other competing physician practice.

We also believe that our results will be beneficial to policymakers who can now better identify practices that are less likely to adopt EMRs given their current external environment and provide them with additional assistance for EMR adoption and use. Moreover, future policies designed to influence the adoption of EMR systems should take into consideration how market factors

interact with financial barriers as a barrier for physicians to adoption. To the extent possible, future incentives and/or education campaigns should address market factors that are out of the control of managers in medical practices. Lastly, knowing the relationship between market factors and EMR adoption may be particularly beneficial to HITECH-funded Regional Extension Centers that aim to assist physicians in adopting EMR systems and achieving meaningful use.

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