

The influence of payer mix on electronic health record adoption by physicians

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Background: Numerous studies have examined the relationship between physician practice characteristics and electronic health record (EHR) adoption. Little is known about how payer mix influences physicians' decisions to implement EHR systems.

Purpose: This study examines how different proportions of Medicare, Medicaid, and privately insured patients in physicians' practices influence EHR adoption.

Methodology: Data from a large-scale survey of physician's use of information technologies in Florida were analyzed. Physicians were categorized based on their responses to questions regarding the proportion of patients in their practice that use Medicare, Medicaid, or private insurance products. The binary dependent variable of interest was EHR adoption among physicians. Adjusted odds ratios (ORs) were computed using logistic regression modeling techniques. The model examined the effect of changes in each payer type on EHR adoption, controlling for various practice characteristics.

Findings: Physicians with the highest percentage of Medicaid patients in their practices were significantly less likely to indicate using an EHR system when compared with those in the low-volume Medicaid group (OR = 0.690; 95% confidence interval [CI] = 0.50–0.95). No differences in EHR adoption were detected among physicians in the low, median, and high Medicare volume classifications. Among the private payer classifications, physicians whose practices were in the median group indicated significantly greater EHR use than those with relatively low levels of privately insured patients (OR = 1.62; 95% CI = 1.16–2.27). Those in the high-volume private payer group were also more likely than the low-volume group to have an EHR system, but this trend did not reach statistical significance (OR = 1.44; 95% CI = 0.96–2.16).

Practice Implications: Governmental insurance programs are either not influencing or *negatively* influencing EHR adoption among physicians in Florida. Given the quality and cost benefits associated with EHR use (particularly for health care payers), policymakers should consider strategies to incentivize or reward EHR adoption among doctors who care for Medicare and Medicaid patients.

Key words: EHR adoption, Medicaid, Medicare, payer mix, physician practices, private insurance

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Electronic health records (EHRs) have the potential to transform health care delivery. Benefits from the use of EHRs include both improved financial and clinical performance (Barlow, Johnson, & Steck, 2004; Hillestad et al., 2005; Wang et al., 2003). Despite these and numerous other benefits (Bates, Ebell, Gotlieb, Zapp, & Mullins, 2003; Erstad, 2003), EHR adoption among U.S. physicians has remained relatively low—in the range of 14 to 25% (Gans, Kralewski, Hammons, & Dowd, 2005; Menachemi, Perkins, Van Durme, & Brooks, 2006; Miller, Hillman, & Given, 2004; Simon, Rundall, & Shortell, 2005).

Research suggests that a variety of barriers to EHR adoption exist (Ash & Bates, 2005; Barlow et al., 2004; Bates, 2005; Miller & Sim, 2004; Valdes, Kibbe, Tolleson, Kunik, & Petersen, 2004). One of the largest barriers to EHR adoption is the upfront cost of hardware and software associated with the acquisition of EHR systems (Audet et al., 2004; Gans et al., 2005). Financial barriers are particularly problematic because physicians typically bear the majority of the costs and do not necessarily reap a significant share of the benefits (Ash & Bates, 2005). Instead, under many reimbursement scenarios, health care payers stand to benefit greatly from the widespread use of EHR systems (Burton, Anderson, & Kues, 2004; Middleton, Hammond, Brennan, & Cooper, 2005).

The combination of different payers that make up a given physician's practice is referred to as payer mix. Given the variability in reimbursement rates for comparable procedures from one payer to another (e.g., Medicaid, Medicare, and private payers), payer mix significantly influences the financial performance of health care organizations (Friedman, Sood, Engstrom, & McKenzie, 2004; Lillie-Blanton et al., 1992). In physicians' practices where operating margins are tighter (Pham, Devers, May, & Berenson, 2004), the financial barrier to EHR adoption is higher compared with practices with greater resource availability. As payer mix negatively impacts a practice's profitability, it will limit the organization's ability to make the large investments necessary to buy an EHR system. Data from an early survey (Burt & Sisk, 2005) found no direct association between payer mix and EHR adoption. However, those data were collected during a time period when EHR adoption was in its infancy and the effect size of the dependent variable was negligible.

To further explore this issue, this study examines the current relationship between payer mix and the adoption of EHR systems by physicians. The remainder of this article is presented as follows. First, we will develop a conceptual framework to guide our analyses. Next, we will present data on EHR adoption from a recently collected statewide survey in Florida. Lastly, after presenting the study's results, we will provide commen-

tary and policy implications for physicians and other health care leaders.

Conceptual Framework

Bates (2005) suggests that low reimbursement rates and the resulting slim operating margins are the most important barrier to the widespread adoption of EHRs. Different payers typically set or negotiate different prices, and certain payers are known to reimburse more generously than others (Friedman et al., 2004). Medicaid is known to have the lowest reimbursement rates for many common services and procedures (Tang, 2004). More than half of physicians surveyed in a previous study cited low reimbursement rates as a very serious problem with the Medicaid system (Shoenman & Cheng, 1999). For this reason, it is common for physicians to reject new Medicaid patients (Brooks, Menachemi, Clawson, & Beitsch, 2005) because in a full practice, serving a lower paying patient means a potential loss of an opportunity to serve a higher paying patient (Hogan, 2003; Pham et al., 2004). As a result, physicians whose practices cater predominately to Medicaid patients will generate less revenue than other physicians (McManus, Flint, & Kelly, 1991). The lower reimbursement rates likely translate into decreased profit margins, thus providing less available capital for discretionary purchases. Cost estimates for EHR systems are \$50,000–70,000 for a three-physician practice and \$10,000–20,000 for each additional physician (Agrawal, 2002; Carter, 2001). Therefore, we hypothesize the following:

H1: As the percentage of patients covered by Medicaid increases as a proportion of all patients in a physician's practice, the likelihood of EHR adoption decreases, all other factors being equal.

Compared with Medicaid, Medicare tends to have significantly higher reimbursement rates for comparable services. National estimates suggest that Medicare, on average, reimburses at a rate of 45% greater than Medicaid (Hogan, 2003). Despite having higher reimbursement rates than Medicaid, some evidence from hospital studies suggests that a larger proportion of Medicare patients is associated with a general decrease in profitability from patient care (Rizzo, 1991). Alternatively, other research evidence suggests that a low share of Medicare patients in a hospital's payer mix increases the risk of its closure (Williams, Hadley, & Pettengill, 1992), suggesting that hospitals rely on Medicare patients to stay solvent. Whether this is true for physicians' practices is unknown. Therefore, it is difficult to determine from the literature how an increase in Medicare patients as a percentage of a given

practice's payer mix will affect overall profitability. Given the mixed finding from the hospital literature, we hypothesize the following:

H2: As Medicare patients increase as a proportion of all patients in a physician's practice, the likelihood of EHR adoption will neither increase nor decrease, all other factors being equal.

Private payers include traditional indemnity insurers, third-party administrators, and managed-care payers. Compared with both Medicaid and Medicare, private payers typically reimburse physicians at higher rates for comparable services. For example, in 2001, the average payment among private insurers was approximately 20% higher than Medicare physician fees (Tang, 2004). As a result, physician practices that have a higher percentage of private payers as a proportion of their payer mix generate greater revenue for seeing the same number of patients with comparable medical conditions. This additional income could allow for greater flexibility in the acquisition of equipment requiring significant capital investments and resources. Therefore, we hypothesize the following:

H3: As private payers increase as a proportion of all patients in a physician's practice, the likelihood of EHR adoption increases, all other factors being equal.

Methods

Survey Data

In the spring of 2005, a large-scale survey of physicians practicing in Florida was conducted. The survey, which was approved by the Florida State University's institutional review board, targeted all primary care physicians in the state and a 25% random sample of other physicians practicing in the ambulatory setting (total $N = 14,921$). Practice mailing addresses were obtained from the state Department of Health, which maintains this information for licensure purposes.

The survey was broadly designed to capture information about general use of information technologies (IT). Specific questions asked about the use of EHR systems by the individual physician respondents in their practice. A complete description of the survey methodology (Menachemi & Brooks, 2006a; Menachemi, Ettl, Brooks, & Simpson, 2006) and an analysis that found no detectable response bias (Menachemi, Hikmet, Stutzman, & Brooks, 2006) have been previously published. Briefly, the survey was developed based on a

comprehensive literature review and refined with the aid of experts' advice to establish content and face validity. Before deployment, the survey instrument was cognitively tested with a panel of physicians for clarity and readability. This process resulted in several iterations prior to the final version of the questionnaire.

Mailed surveys were tracked by a six-digit identification code so that nonresponders could be sent a follow-up survey with a letter encouraging their participation. Physicians who indicated by mail, telephone, or e-mail that they were no longer seeing patients were excluded. The questionnaires were mailed back to a university-based survey research laboratory, where the data were entered into a computer database and subjected to data verification and cross-check methodologies.

Measuring Payer Mix

Friedman et al. (2004) suggest that patients in the United States who have third-party payers be classified into four payer groups: Medicaid, Medicare, private insurance, or uninsured. The later category is not actually a payer and applies more commonly to hospitals and other health care facilities as opposed to physician practices. As such, the current analyses focus on Medicaid, Medicare, and private payers only.

Our survey included questions that asked respondents to indicate what percentage of their practice was made up of Medicaid, Medicare, and private insurance patients. Responses for each of these questions could vary between 0 and 100%. Although these variables were continuous, their distribution (as expected) was not normal. Moreover, the measures were self-reported estimates by the physicians. As such, to facilitate analyses and to more accurately classify the estimates, each variable was separately categorized into quartiles. In the Medicaid variable, physicians who self-reported a practice composition of 0% Medicaid patients represented the bottom quartile. To be consistent with the other measures below, these physicians are herein referred to as low-volume Medicaid physicians even though they did not have any Medicaid patients. High-volume Medicaid physicians were those in the top quartile and had a practice composition of at least 75% Medicaid patients. The middle two quartiles were grouped together and referred to as the "typical" (i.e., median) Medicaid volume group.

The Medicare and private insurance variables were also trichotomized. Specifically, low-volume Medicare physicians (those in the bottom quartile for this variable) had a practice composition of less than 25% Medicare patients. High-volume Medicare physicians (those in the top quartile) reported having at least 60% of their practice made up of Medicare patients. Lastly, private insurance patients in the low-volume category of

this variable represented physicians whose practice had less than 20% privately insured patients, whereas those in the high-volume category had at least 60% privately insured patients.

Lastly, our models included an additional categorized variable that controlled for self-paying or uninsured patients. The inclusion of this variable, which did not significantly predict EHR adoption, did not alter the results. Overall, the results of this variable are not presented because, by virtue of the survey question, both self-paying (e.g., elective procedures) and uninsured (e.g., charity care) patients were lumped into the same category.

Statistical Analyses

To analyze the data, standard descriptive statistics were used. In addition, we used logistic regression modeling techniques to compute adjusted odds ratios (ORs). The dependent variable of interest was EHR adoption among physicians. Independent variables included each of the payer type variables (Medicaid, Medicare, and private payers) and several control variables that were available from the primary survey data. These control variables included practice size, practice type (single or multi-specialty), geographic location (rural or urban), and years in practice (measured in years since the physician graduated from medical school). Based on previous work examining physician offices and IT adoption (Audet et al., 2004), practice size was categorized as solo practice, 2–9 physicians, 10–49 physicians, and 50 or more physicians. Practice type and geographic location were both measured dichotomously, and years since medical school graduation was measured as a continuous variable.

Results

The sample for the current study included 4,203 physicians in Florida who responded to the survey described above. The demographic and practice characteristics of these respondents appear in Table 1. Overall, their demographics did not differ from known characteristics of Florida physicians (Pasko & Smart, 2004). The average practice was composed of 41.8% privately insured patients, 32.2% Medicare patients, 13.9% Medicaid patients, and 11.5% self-pay or other.

Of the 4,203 respondents, 995 (23.7%) indicated that they were currently using an EHR system. In univariate analysis, an increase in Medicaid patient composition was related to a decrease in EHR adoption. For example, low-volume Medicaid physicians (24.3%) had adopted EHR systems more frequently than high-volume Medicaid physicians (20.2%; $\chi^2 = 5.73$, $p = .05$). Alternatively, low-volume Medicare physicians

had adopted EHR at a significantly lower rate (18.7%) than both typical Medicare practices (middle quartiles, 24.7%) and high-volume Medicare physicians (25.9%; $\chi^2 = 23.45$, $p < .001$). Lastly, physicians in the typical (25.7%) and high-volume private payer (19.6%) groups were more likely to adopt EHR than those in the low-volume private payer category (18.1%; $\chi^2 = 25.08$, $p < .001$).

Results from the multivariate regression model appear in Table 2. When controlling for the practice characteristics described above, those in the high-volume Medicaid group were still significantly less likely to indicate using an EHR system when compared with those in the low-volume Medicaid group (OR = 0.690; 95% confidence interval [CI] = 0.50–0.95).

When examining the Medicare variable in multivariate analyses, no differences among the groups were detected. However, among the private payer variable, an increase from the low-volume group to the typical group was associated with a significant increase in EHR use (OR = 1.62; 95% CI = 1.16–2.27). Those in the high-volume private payer group were also more likely than

Table 1

Physician demographic and practice information

	Respondents
Demographics	
Gender, male	2,479 (75.9%)
Race/Ethnicity	
Caucasian	2,875 (68.4%)
Hispanic	539 (12.8%)
Asian	433 (10.3%)
African-American	133 (3.2%)
Other (or unknown)	223 (5.3%)
Mean years since medical school graduation (range)	21.3 (<1–>65)
Practice characteristics	
Practice size	
Solo practice	1,228 (30.9%)
2–9 physicians	2,150 (54.2%)
10–49 physicians	385 (9.7%)
50 or more physicians	206 (5.2%)
Practice type	
Single specialty	2,713 (85.6%)
Multispecialty	457 (14.4%)
Geographic location	
Rural	245 (5.8%)
Urban	3,950 (94.2%)
Payer type (mean)	
Medicaid	13.9%
Medicare	32.2%
Private insurance	41.8%
Self-pay or other	11.5%

Table 2**The association of payer mix and EHR adoption by physicians in Florida (N = 4,203)**

	EHR adoption	
	Percentage	Odds ratio (95% CI)
Payer mix: independent variables		
Medicaid practice composition^a		
No Medicaid patients (bottom quartile)	24.3	1.00
Typical volume (middle quartiles)	22.1	0.888 (0.71–1.11)
High volume (top quartile)	20.2	0.690 (0.50–0.95)
Medicare practice composition^b		
Low volume (bottom quartile)	18.7	1.00
Typical volume (middle quartiles)	24.7	1.11 (0.84–1.47)
High volume (top quartile)	25.9	1.33 (0.94–1.88)
Private insurance practice composition^c		
Low volume (bottom quartile)	18.1	1.00
Typical volume (middle quartiles)	25.7	1.62 (1.16–2.27)
High volume (top quartile)	19.6	1.44 (0.96–2.16)
Control variables		
Practice size		
Solo practice	13.8	1.00
2–9 physicians	20.4	1.22 (0.97–1.54)
10–49 physicians	45.2	3.81 (2.56–5.67)
50 or more physicians	72.8	13.9 (7.80–25.0)
Practice type		
Single specialty	17.8	1.00
Multispecialty	40.5	1.27 (0.95–1.71)
Geographic location		
Urban	24.1	1.00
Rural	17.6	0.90 (0.59–1.38)
Years since graduating medical school^d		0.97 (0.96–0.98)

Note: Logistic regression was used to compute the adjusted odds ratio, controlling for variables listed in the table. EHR = electronic health record. CI = confidence interval.

^aNo Medicaid patients (0% practice composition) represents the bottom quartile in distribution. High-volume Medicaid (greater than 75% practice composition) represents the top quartile in distribution.

^bLow-volume Medicare (less than 25% practice composition) represents the bottom quartile in distribution. High-volume Medicare (greater than 60% practice composition) represents the top quartile in distribution.

^cLow-volume private payer (less than 20% practice composition) represents the bottom quartile in distribution. High-volume private payer (greater than 60% practice composition) represents the top quartile in distribution.

^dMeasured on a continuous scale.

those in the low-volume group to have an EHR system, but this trend did not reach statistical significance (OR = 1.44; 95% CI = 0.96–2.16).

Discussion

Several studies have identified factors that facilitate or obstruct the adoption of EHR systems among physicians (Audet et al., 2004; Gans et al., 2005; Menachemi & Brooks, 2006a; Miller et al., 2004). However, to our knowledge, only one study has reported information regarding the association of payer mix and EHR use:

that of Burt and Sisk (2005). That previous study, which found no relationship between EHR use and payer type, was based on data collected in 2001, when EHR adoption was still rare. This study was designed to more closely examine the relationship between payer mix and EHR use now that the technology is being more widely used. Given the ongoing efforts of policymakers and other health care leaders to increase the adoption of this important technology, the present analyses provide valuable information regarding how physicians' decision making may be influenced by the mix of third-party payers in their practices.

Based on the literature, we hypothesized that an increase in Medicaid patients in a given physician's practice would be negatively associated with EHR adoption. The empirical analyses found strong support for this assertion. Specifically, physicians whose practices were made up of at least 75% Medicaid patients were 31% less likely to have indicated the adoption of an EHR system compared with physicians who do not serve Medicaid patients. This significant trend, which held true even after controlling for several practice characteristics, raises important issues regarding the care received by Medicaid patients. Given that EHR use is associated with improved quality (Menachemi & Brooks, 2006b) and increased care coordination (Burton et al., 2004), the question is, "Are Medicaid patients systematically receiving lower quality care than the rest of the population due to a lack of health IT in the medical practices they use?" The answer to this question remains unanswered and should be the focus of future research.

Of note, in Florida, the Medicaid program has been very successful in influencing the use of health IT among physicians. In a program designed to improve quality outcomes and decrease rising state costs, the State of Florida provided high-volume Medicaid physicians with hot-synching handheld computers for use in their clinical duties. That program has positively influenced the use of handheld computers among physicians (Menachemi & Brooks, 2006a; Wood, 2004) and demonstrates the important role that Medicaid can play in influencing technology adoption among physicians. Given the findings of the current study, state Medicaid programs should consider providing direct incentives for EHR adoption among physicians who care for a large number of Medicaid patients.

The current study found that changes in the proportion of patients covered by Medicare as a percentage of a physician's practice had no relationship to the adoption of EHR systems in Florida. This finding, which supports the second hypothesis, highlights a missed opportunity for Medicare to influence this issue in a positive way. Following the call of President Bush (2004) for universal EHR adoption, the Centers for Medicare and Medicaid Services designed and piloted several programs to incentivize and/or reward the use of EHRs (Chin, 2005). More research will be needed to evaluate the ultimate success of those programs; however, the current findings suggest that the effects of such programs have not yet been realized in Florida.

The empirical analysis of this study found partial support for the third hypothesis. The literature review indicated that increases in the proportion of a physician's practice that is made up of privately insured patients would result in a greater likelihood of EHR adoption. With respect to the private insurance variable, we found that only the median group was more likely than the

lowest group to indicate the use of an EHR system. Physicians in the highest quartile (at least 60% of patients are privately insured) did not differ in a statistically significant way from those in the lowest quartile. This suggests that although payer generosity may play some role in the EHR adoption decision, other factors may be influencing adoption as well. To explore this trend more fully, future research should examine the differing effects of managed care and traditional indemnity insurance types on EHR adoption by physicians.

Two potential limitations exist in our study. First, given the nature of the survey method used, our data rely on the willingness and ability of participants to give accurate responses. Surveys, like ours, that do not achieve perfect participation rates are susceptible to response bias. However, none was detected in a formal assessment (Menachemi, Hikmet, et al., 2006) using established methodologies (Etter & Perneger, 1997; Hansen & Hurwitz, 1946; Hikmet & Chen, 2003). Moreover, our main independent variable, payer mix, was a self-reported estimate. This variable, in particular, may have been subject to recall bias. Nevertheless, by conflating responses into quartiles, we may have overcome this issue by classifying respondents into broader, but more accurate, groups. Second, our cross-sectional study used data from one state, at a single point in time. As such, generalizability to other locations and causality should be inferred with caution.

Implications for Management Practice

The current study has implications to managers in physician practices and administrators of Medicare and Medicaid programs. At the medical practice level, managers should consider how changes in their practice's payer mix may affect their ability to invest in an EHR system. An increase in Medicaid patients, for example, may correspond with scarcer resource availability, which may ultimately negatively influence the decision to adopt EHR. Also, practice-level managers can take advantage of local opportunities to work with several entities concerned with the adoption of EHR systems. Among these entities are Medicare quality improvement organizations, regional health information organizations, professional medical societies, and, in some cases (including Florida), state government.

Overall, we found that practices that cater to a large number of Medicaid patients were least likely to have adopted an EHR system. Moreover, the proportion of Medicare patients as a percentage of a given physician's practice did not correlate with EHR use. This suggests that physicians who care for an increasing number of patients covered by governmental insurance types either are not being influenced or are being negatively

influenced to adopt an important technology that can improve care and reduce costs.

Knowing this creates an opportunity for administrators at the federal Medicare and state Medicaid programs. Policymakers at the state and federal governmental entities responsible for Medicaid and Medicare, respectively, should formulate direct strategies to reverse the trends identified in the current study. Ultimately, the adoption of EHR systems by physicians is likely to improve quality and save on costs for all payers. An opportunity exists for the governmental agencies to play a large role in influencing the adoption curve of this important technology.

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