Electronic Health Records and Malpractice Claims in Office Practice

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Background: Electronic health records (EHRs) may improve patient safety and health care quality, but the relationship between EHR adoption and settled malpractice claims is unknown.

Methods: Between June 1, 2005, and November 30, 2005, we surveyed a random sample of 1884 physicians in Massachusetts to assess availability and use of EHR functions, predictors of use, and perceptions of medical practice. Information on paid malpractice claims was accessed on the Massachusetts Board of Registration in Medicine (BRM) Web site in April 2007. We used logistic regression to assess the relationship between the adoption and use of EHRs and paid malpractice claims.

Results: The survey response rate was 71.4% (1345 of 1884). Among 1140 respondents with data on the presence of EHR and available BRM records, 379 (33.2%) had EHRs. A total of 6.1% of physicians with an EHR had a history of a paid malpractice claim compared with 10.8% of physicians without EHRs (unadjusted odds ratio, 0.54; 95% confidence interval, 0.33-0.86; $P=.01$). In logistic regression analysis controlling for sex, race, year of medical school graduation, specialty, and practice size, the relationship between EHR adoption and paid malpractice settlements was of smaller magnitude and no longer statistically significant (adjusted odds ratio, 0.69; 95% confidence interval, 0.40-1.20; $P=.18$). Among EHR adopters, 5.7% of physicians identified as "high users" of EHR had paid malpractice claims compared with 12.1% of "low users" ($P=.14$).

Conclusions: Although the results of this study are inconclusive, physicians with EHRs appear less likely to have paid malpractice claims. Confirmatory studies are needed before these results can have policy implications.

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In the past 10 years, health information technology (HIT) has emerged as an essential component of a transformed health care system that focuses on safety, quality, and efficiency.[1,2] Although results of some studies have been equivocal,[3,4] the potential impact of HIT on the safe practice of medicine seems increasingly compelling: if used actively by caregivers, studies indicate that HIT can reduce adverse drug events and improve physician performance in areas such as diagnosis, preventive care, disease management, drug dosing, and drug management.[5,6] One component of HIT in particular, electronic health records (EHRs), has been targeted by policymakers as an essential tool for ensuring the secure availability of patient health records across health care entities and for reducing health care spending.[7] Many clinicians have also recognized the benefits of implementing an EHR despite the large initial capital expenditure. Research indicates that EHRs can improve documentation, enhance the efficiency of clinic visits,[8] minimize medication errors, and enable clinicians to perform population surveillance and monitoring.[2,9] As a result, EHRs are being increasingly adopted by caregivers seeking to improve the quality of patient care.[10]

The potential for EHRs to prevent adverse events and reduce health care costs has also created interest in whether use of EHRs reduces the risk of malpractice lawsuits. The Joint Commission on Accreditation of Healthcare Organizations has suggested that HIT can address factors that have proved to be risk points for error and subsequent malpractice suits by patients, such as communication among caregivers, availability of patient information, medication prescribing, and adherence to clinical guidelines.[11] One study[12] that involved 307 closed malpractice cases claiming medical negligence found that more than half of the cases were due to diagnostic errors that harmed patients. Most of these errors occurred because of fail-

ure to order diagnostic tests or lack of a follow-up plan. Because EHRs and HIT seem to mitigate reliance on cognitive factors through clinical decision support and avoidance of errors of omission, diagnostic errors may in turn decrease with implementation of such systems. Furthermore, electronic documentation tends to be superior to the paper record in legibility and completeness. Since many lawsuits hinge on the presentation of proper documentation to the court, a thorough and accurate medical record would likely make lawsuits easier to defend for physicians.[13] Many malpractice claims also base their allegations on the failure to adhere to the standard of care. With the inclusion of decision support into an EHR, physicians can be presented with the relevant guidelines from the onset of ordering treatment and may be more likely to adhere to them.

In addition, malpractice claims due to medical errors constitute the bulk of malpractice claim payouts and administrative costs.[14] Of all malpractice claims, 83% show no evidence of negligence, and most of these claims without injury are uncompensated or account for a small fraction of overall malpractice costs.[14,15] Thus, if medical errors were minimized through HIT, significant health care savings would occur through a reduction in tort-associated costs. Conversely, some studies[16,17] have shown that HIT has the potential to increase adverse events attributable to information errors and human-machine interface flaws. Although these reports primarily focus on computerized physician order entry systems in hospital settings, the fact remains that adoption of any HIT is not without risk, and unintended consequences may create a new realm of litigation issues.

Despite a considerable body of evidence indicating that HIT can prevent medical errors, little is known about the relationship between EHR adoption in the office practice setting and medical malpractice claims. Few data are available to evaluate the association between use level of EHR functions and the prevalence of malpractice claims. In the inpatient setting, use of computerized physician order entry was correlated with a lower frequency of medication-related malpractice claims,[18] but the frequency of these claims is low enough to make such analyses difficult. To assess whether EHR use was associated with fewer paid malpractice claims, we linked survey data about EHR adoption and use to physician profile data from the Massachusetts Board of Registration in Medicine (BRM).

METHODS

The sampling methods, survey questionnaire development, and survey administration have been published elsewhere[19,20] and are described briefly herein.

SAMPLE

Using a database from a private vendor (Folio Associates, Hyannis, Massachusetts) and information from the BRM,[21] we identified the population of practicing physicians in Massachusetts in 2005. After excluding physicians who were residents in training, retired, or without direct patient-care responsibilities, the total population of physicians was 20 227. These physicians practiced in 6174 unique practice sites in Massachusetts. Of these practices, a stratified random sample of 1921 practices was obtained, and 1 physician from each practice was randomly selected for the survey. After excluding practices that had closed, the final sample size was 1884 physicians.

SURVEY

We administered a survey by mail between June 1, 2005, and November 30, 2005, to physicians in office practice in Massachusetts. The 8-page questionnaire was based on a systematic review of the literature regarding barriers to EHR adoption and ascertained physician and practice characteristics, adoption of EHRs and other HIT, and use of EHR functions. Initially, the survey was sent via express mail with a $20 cash honorarium. Two subsequent mailings to nonresponders were sent without remuneration. Between mailings, multiple telephone contacts were attempted to remind physicians to complete the survey.

The survey ascertained physicians' personal demographic and practice characteristics and their use of HIT, including EHRs. Physicians reported their age; race, which we dichotomized as white vs other; year of medical school graduation; and number of physicians in their practice. We determined each physician's specialty from the database from which we drew the survey sample.

MALPRACTICE CLAIMS DATA COLLECTION

In April 2007, available identifying data (name, date of graduation, and zip code) were used to access each survey respondent's physician profile on the BRM Web site (http://profiles.massmedboard.org/MA-Physician-Profile-Find-Doctor.asp). The BRM Web site contains information only for the previous 10 years of the physician's practice. Two trained data extractors (including A.V.), blinded to the physicians' responses to the survey questionnaire and the specialties of the physicians, independently determined the presence or absence of a paid malpractice claim for each study physician from the BRM Web site. If a paid malpractice claim was present, then number of claims and year of the settlement payment was noted.

Data collection sheets from the 2 data extractors were compared for accuracy, and any discrepancies were adjudicated using the BRM Web site. After a master data extraction form was compiled, the names and addresses of the respondents were removed and pertinent measures from the survey were merged. The study protocol was approved by the Partners HealthCare Human Research Committee.

STATISTICAL ANALYSIS

Statistical analysis was performed using commercially available software programs (Stata Intercooled 9; StataCorp, College Station, Texas; and SAS statistical software, version 9.1; SAS Institute Inc, Cary, North Carolina). Baseline characteristics between respondents who were EHR adopters and nonadopters, as well as between physicians with and without paid malpractice claims, were compared using the Pearson χ^2 test, the Wilcoxon rank sum test, and the unpaired, 2-tailed t test. The primary outcome, the presence or absence of paid malpractice claims among physicians using EHRs and those not using EHRs, was assessed using the Pearson χ^2 and Fisher exact test, as appropriate, and calculating unadjusted odds ratios (ORs) with 95% confidence intervals (CIs).

We used logistic regression to adjust for the potential influence of physician characteristics on the relationship between EHR and malpractice claims. The model was run first with all covariates and then with inclusion only of those variables found to be statistically significantly associated ($P<.05$)

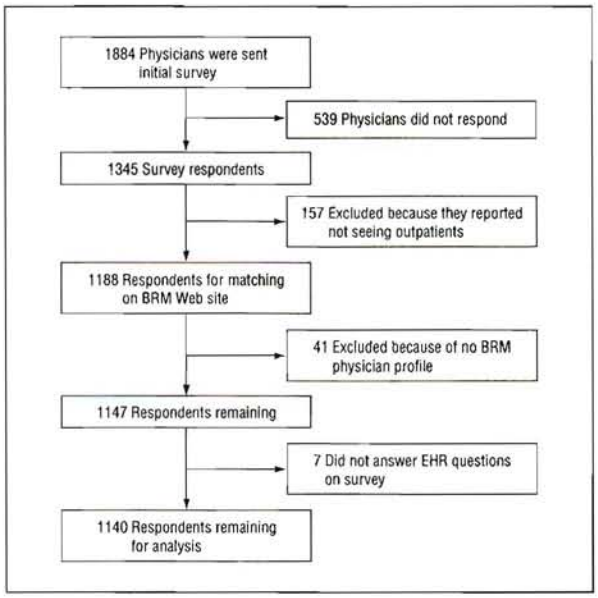

Figure. Flow diagram of included and excluded survey respondents. BRM indicates Board of Registration in Medicine; EHR, electronic health record.

with paid malpractice claims in bivariate analysis. Because age and graduation year were highly correlated, only graduation year (a proxy for years in practice) was used in the logistic regression models. In an exploratory analysis to address the potential temporal relationship between EHR adoption and the prevention of malpractice settlements, we excluded any physicians who had paid malpractice claims the date of which preceded the date of EHR adoption. In this analysis, we also excluded any physicians who had adopted EHRs after 2001 based on the assumption that it would take a minimum of 5 years for a malpractice event to result in a paid settlement.

A subsequent analysis limited to EHR adopters examined the relationship between use of EHR functions and paid malpractice claims. Physicians with EHRs were asked to document the availability and degree of use of 10 key functions in their EHR. Those who used half or more of their available functions all or most of the time were considered "high EHR users," whereas the remaining physicians were classified as "low users."[20] The rate of paid malpractice claims among high and low users was compared using the χ^2 test.

To determine whether the relationship between EHR adoption and paid malpractice claims was similar among physicians in specialties considered high risk vs low risk for malpractice claims, we first determined the percentage of physicians with paid malpractice claims in each specialty within our data set. The percentages ranged from 0% (dermatology) to 34.6% (general surgery). We dichotomized the sample at the median (10.5%) to create a variable that indicated whether each physician practiced in a low-risk or high-risk specialty. For example, internal medicine (7.1%) and family medicine (10.5%) were considered in the low-risk group, whereas obstetrics and gynecology (24.2%) and urology (30.8%) were in the high-risk group. We then examined the relationship between the presence of EHR and paid malpractice settlements within each stratum.

RESULTS

As reported previously,[19,20] 1345 physicians completed the survey (response rate, 71.4%). We excluded 157 physicians who indicated that they did not see outpatients and 41 physicians who did not have physician profiles on the BRM Web site (**Figure**). Seven physicians did not answer survey questions regarding use of EHRs. This resulted in 1140 respondents eligible for analysis.

Table 1. Characteristics of EHR Adopters and Nonadopters[a]

Characteristic	EHR Adopters (n=379)	EHR Nonadopters (n=761)	*P* Value
Age, mean (SD), y	49.1 (9.6)	52.8 (10.7)	<.001
Women	133 (35.7)	224 (29.9)	.05
White race	308 (84.9)	619 (84.9)	.98
Median year of medical school graduation (IQR)	1987 (1980-1993)	1983 (1974-1991)	<.001
Practice size			<.001
Solo practice	53 (14.2)	268 (35.9)	
2-4 Physicians	71 (19.0)	268 (35.9)	
5-9 Physicians	110 (29.5)	131 (17.5)	
≥10 Physicians	139 (36.3)	80 (10.7)	
Primary care[b]	149 (40.2)	297 (39.5)	.83

Abbreviations: EHR, electronic health record; IQR, interquartile range.
[a] Data are presented as number (percentage) of study participants unless otherwise indicated. Categories do not sum to 1140 because of participant nonresponse; denominators vary for the same reason.
[b] Primary care included family practice, general internal medicine, general pediatrics, combined medicine and pediatrics, and geriatrics.

EHR ADOPTION

Overall, 33.2% of the sample (379 of 1140) used EHRs in their practices (**Table 1**). Physicians who used EHRs were younger than those who did not use EHRs (mean age, 49.1 vs 52.8 years; $P<.001$) and had completed medical school more recently (median graduation year, 1987 vs 1983; $P<.001$). The EHR adopters were less likely to be in solo practice (14.2% vs 35.9%; $P<.001$). Among physicians who used EHRs, 71.8% reported implementing their systems within the 10 years preceding the survey. Duration of EHR use ranged from less than 1 year to 18 years among survey respondents who used EHRs in their practice.

PAID MALPRACTICE CLAIMS

A total of 105 of the 1140 survey respondents (9.2%) had a history of 1 or more malpractice payments within the past 10 years (**Table 2**). Paid malpractice claims were more common among male physicians (11.1%) than female physicians (5.6%) ($P=.003$). Paid malpractice claims were more common among physicians who had been in practice longer. For example, 15.2% of physicians who graduated from medical school more than 20 years ago had paid malpractice claims in the past 10 years compared with 5.8% of physicians who had graduated within the past 20 years ($P<.001$) (data not shown). Practice size was also correlated with malpractice claims. Paid malpractice claims were more common among physicians in solo practice (43.7%) and among those in small group practices of 2 to 4 people (29.1%) and 5 to 9 people (19.4%) than among physicians who practiced in groups of 10 or more physicians (7.8%).

Among physicians who used EHRs, 6.1% had a record of paid malpractice claims compared with 10.8% of physicians who did not use EHRs (unadjusted OR, 0.54; 95% CI, 0.33-0.86; $P=.01$) (Table 2). In logistic regression analysis controlling for physician sex, race, year of medical school graduation, specialty, and practice size, the relationship between EHR adoption and paid malpractice settlements was of smaller magnitude and no longer statistically significant (adjusted OR, 0.69; 95% CI, 0.40-1.20; $P=.18$) (**Table 3**). A more parsimonious model that adjusted only for variables found to be associated with the outcome variable demonstrated a relationship between EHR adoption and paid malpractice claims (OR, 0.68; 95% CI, 0.40-1.16; $P=.16$) that did not materially differ from the fully adjusted model.

In the exploratory analysis that excluded physicians who had adopted EHRs after 2001 and those with paid malpractice settlements the date of which preceded the EHR adoption date, the resultant sample was limited to 117 EHR adopters, of whom 2 (1.7%) had paid malpractice settlements. In logistic regression analysis, controlling for physician sex, year of medical school graduation, and practice size, a significant association was found, indicating that physicians with EHRs were less likely to have paid malpractice claims (adjusted OR, 0.19; 95% CI, 0.05-0.78). The power for this analysis was extremely small because of the small number of outcomes in EHR adopters, and excluding subjects from this group in a nonrandom manner may have led to a more biased result.

Within the physician group that used EHRs, 299 physicians were characterized as high users and 33 as low users. Seventeen of the high users (5.7%) had paid malpractice claims compared with 4 of the low users (12.1%) ($P=.14$). Among the 105 physicians with any paid malpractice claims, 16 had multiple paid claims during the observation period, 3 of whom had EHRs. This prevalence of EHR adoption among physicians with multiple claims (3 of 16 physicians [18.8%]) was similar to that among those with only 1 paid claim (20 of 89 [22.5%]) ($P=.74$). In stratified analyses, the relationship between the presence of EHR and paid malpractice claims was similar among physicians practicing in high-risk specialties (OR, 0.55; 95% CI, 0.27-1.12; $P=.10$) and those in low-risk specialties (0.51; 0.26-1.00; $P=.05$).

Table 2. Characteristics of Physicians With Malpractice Settlements[a]

Characteristic	Physicians With Malpractice Settlements (n=105)	Physicians Without Malpractice Settlements (n=1035)	*P* Value
Age, mean (SD), y	49.5 (10.7)	54.1 (8.7)	<.001
Median year of medical school graduation (IQR)	1977 (1971-1985)	1986 (1977-1992)	<.001
Graduated medical school before 1980	62 (59.0)	346 (33.4)	<.001
Women	20 (19.0)	337 (33.1)	.003
White race	88 (86.3)	839 (84.7)	.77
Practice size			<.001
Solo practice	45 (43.7)	276 (27.1)	
2-4 Physicians	30 (29.1)	309 (30.4)	
5-9 Physicians	20 (19.4)	221 (21.7)	
≥10 Physicians	8 (7.8)	211 (20.8)	
Primary care[b]	39 (37.5)	407 (39.9)	.67
EHR adoption	23 (21.9)	356 (34.4)	.009

Abbreviations: EHR, electronic health record; IQR, interquartile range.
[a]Data are presented as number (percentage) of study participants unless otherwise indicated. Data were missing for sex (n=18), race (n=48), practice size (n=20), specialty (n=17), and any component of EHRs in practice (n=1). Denominators vary because of missing data.
[b]Primary care included family practice, general internal medicine, general pediatrics, combined medicine and pediatrics, and geriatrics.

Table 3. Correlates of Paid Malpractice Claims From a Logistic Regression Model[a]

Characteristic	Adjusted OR (95% CI)	*P* Value
EHR adoption	0.69 (0.40-1.20)	.18
Medical school graduation year	0.96 (0.95-0.98)	<.001
Women	0.59 (0.34-1.02)	.06
White race	0.92 (0.49-1.71)	.78
Practice size		
Solo practice	2.39 (1.03-5.53)	.04
2-4 Physicians	2.20 (0.95-5.10)	.07
5-9 Physicians	2.30 (0.97-5.47)	.06
≥10 Physicians	1 [Reference]	
Primary care	1.00 (0.64-1.56)	.99

Abbreviations: CI, confidence interval; EHR, electronic health record; OR, odds ratio.
[a]Model adjusted for EHR adoption status, year of medical school graduation, sex, race, practice size, and specialty.

COMMENT

In this cross-sectional study, we found that physicians who used EHRs were less likely to have paid malpractice claims compared with physicians who did not use EHRs. Although this relationship is partially confounded by physician sex, year of medical school graduation, and practice size, the presence of EHR appears to be associated with a lower malpractice risk. This impression is further strengthened by the observed trend among physicians with EHRs that suggests lower rates of paid malpractice claims among more avid users of their EHR systems.

Few previous studies have directly examined the relationship between EHR adoption and malpractice claims. Although 1 study[18] found that computerized physician order entry was associated with a lower rate of malpractice claims in the hospital, studies of HIT and malpractice claims in the ambulatory setting have been lacking. The results of this study support the hypothesis that EHR adoption and use lead to improved quality of care and patient safety, resulting in fewer adverse events and fewer paid malpractice claims. A number of mechanisms could be responsible for a lower frequency of malpractice claims. For example, use of EHRs may lead to fewer diagnostic errors, improved follow-up of abnormal test results, better guideline adherence, and fewer adverse clinical events. Alternatively, EHRs may be facilitating more extensive

and more legible documentation of medical practice, resulting in stronger legal defenses when malpractice suits are filed. In addition, EHRs may be enhancing patient-physician communication, an important determinant of malpractice claims.[22]

If confirmed in future studies, the observed relationship between EHR adoption and paid malpractice claims could have implications for physicians and malpractice insurers. First, for practices struggling to reconcile the expense of investing in HIT,[19] the potential benefit of fewer malpractice claims may tip the scale toward EHR adoption. Second, if EHRs are proved to be an effective tool in minimizing tort claims and improving patient safety, insurance companies may lower malpractice premiums for practices with EHRs. Currently, most liability insurers adjust physicians' premiums by specialty, location, and past malpractice experience.[23,24] We are familiar with 1 carrier that has instituted a premium credit for physicians and practices with EHRs.[25] If other carriers follow, lower malpractice premiums could provide an additional incentive for clinicians considering the purchase of an EHR system for an office practice.

The relationship between EHR adopters and malpractice claims also has potential health care policy implications. If confirmed in future studies, our results may give the federal government and other payers further incentive to fund subsidies for EHR adoption because of the additional reduction in health care costs through a decrease in medical liability and associated costs.

A strength of this study is its use of verified paid malpractice claims rather than claims filed. Because most closed malpractice claims have proved negligence,[14] by identifying only claims that had been paid out rather than those filed, we were able to exclude lawsuits whose outcome was still in doubt, as well as so-called frivolous lawsuits. In addition, our survey enabled us to examine not only EHR adoption but also use of key EHR functions as they relate to paid malpractice claims.

This study has several important limitations. Although provocative, our findings are inconclusive. They should not be interpreted as establishing a causal link between EHR adoption and the prevention of malpractice claims. It is possible that unmeasured confounding accounts for the fact that physicians who use EHRs may be less likely to be subjects of successful malpractice litigation. For instance, use of EHR may be an intermediate marker for preestablished physician behaviors or practice variations that may lead to a reduction in malpractice claims.

Another limitation is our data source for malpractice claims, the BRM Web site, which indicates only paid malpractice settlements; malpractice suits that were dismissed or still in process are not included. Furthermore, detailed information regarding the nature of the claim is not available. Relying on paid malpractice settlements created a 5-year or longer time lag between the time when the putative error and adverse event occurred and the time when the claim was settled and paid. Moreover, because the BRM posts data on physicians only for the preceding 10 years, additional malpractice claims for physicians in practice earlier than this period may not have been captured.

To compensate for these cross-sectional limitations, future studies would ideally include a longitudinal data source that would record the physician's date of EHR implementation and use, along with the date of the liable incident, filing date, and its outcome. Such studies would require an observation period of many years to account for the time lag between the malpractice-related event and the consequent settlement process. We conducted an exploratory analysis to isolate the temporal relationship between EHR adoption and paid malpractice settlements that yielded results consistent with the primary analyses; however, this exploratory analysis must be interpreted with caution because of the small number of outcomes observed and the resulting imprecision of the effect estimate.

An additional limitation is that this study was conducted among physicians licensed in Massachusetts, and the results may not be applicable to the remainder of the nation. On the basis of a previous analysis,[19] Massachusetts EHR adoption rates (23% of practices and 45% of physicians) are considerably higher than rates observed nationwide. The percentage of Massachusetts physicians with malpractice claims may also be different from the national average. The Kaiser Family Foundation reported that, in 2007, Massachusetts had 8 claims per 1000 nonfederal physicians, half of the national average.[26] Notably, this rate is consistent with a 2004 BRM report[27] that reviewed malpractice data from 1994 to 2003. Whether the relationship between EHRs and malpractice claims differs across states remains to be studied.

In conclusion, the results of this study should be considered preliminary. The findings suggest that physicians with EHRs may have a lower prevalence of paid malpractice claims than physicians without EHRs. Further study is needed to clarify this relationship and the mechanisms that may underlie it.

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