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Opioid Prescribing by Physicians With and Without Electronic Health Records

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Abstract

Background—Physicians in the U.S. are adopting electronic health records (EHRs) at an unprecedented rate. However, little is known about how EHR use relates to physicians' care decisions. Using nationally representative data, we estimated how using practice-based EHRs relates to opioid prescribing in primary care.

Methods—This study analyzed 33,090 visits to primary care physicians (PCPs) in the 2007–2010 National Ambulatory Medical Care Survey. We used logistic regression to compare opioid prescribing by PCPs with and without EHRs.

Results—Thirteen percent of all visits and 33 % of visits for chronic non-cancer pain resulted in an opioid prescription. Compared to visits without EHRs, visits to physicians with EHRs had 1.38 times the odds of an opioid prescription (95 % CI, 1.22–1.56). Among visits for chronic non-cancer pain, physicians with EHRs had significantly higher odds of an opioid prescription (adj. OR=1.39; 95 % CI, 1.03–1.88). Chronic pain visits involving electronic clinical notes were also more likely to result in an opioid prescription compared to chronic pain visits without (adj. OR=1.51; 95 % CI, 1.10–2.05). Chronic pain visits involving electronic test ordering were also

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more likely to result in an opioid prescription compared to chronic pain visits without (adj. OR=1.31; 95 % CI, 1.01–1.71).

Conclusions—We found higher levels of opioid prescribing among physicians with EHRs compared to those without. These results highlight the need to better understand how using EHR systems may influence physician prescribing behavior so that EHRs can be designed to reliably guide physicians toward high quality care.

Keywords

Electronic health records; Opioid prescribing; Primary care; Electronic test orders; Electronic clinical notes

Introduction

Primary care physicians (PCPs) in the U.S. are adopting and using electronic health records (EHRs) at an unprecedented rate. This move toward widespread EHR use is driven by a widespread belief that EHRs can help improve care quality and by recent federal programs that provide reimbursement payments and technical support to office-based physicians who adopt and "meaningfully use" electronic health records (EHRs) [1]. In fact, between 2011 and mid-2013, over 290,000 individual clinicians received federal reimbursement payments for using EHRs [2]. Moreover, in the first 18 months of reimbursement payments, family practitioners accounted for 23 % of payments and primary care providers more generally accounted for 44 % of payments [3].

As motivation for supporting EHR use, clinicians, policy makers, and technology advocates tout EHRs' potential to improve health care quality and safety [4, 1, 2, 5, 6, 3]. However, to date researchers have rarely estimated national-level relationships between EHR use and office-based physicians' behavior, care quality, or patient safety. Furthermore, the few studies that have compared EHR users and non-EHR users on a national scale, have found physicians with EHRs do not systematically deliver higher quality care and may even deliver lower quality care in some clinical scenarios [7–9]. Therefore, as PCPs across the country rapidly adopt EHRs, more research is needed to understand if EHR use is systematically related to differences in how PCPs deliver care, especially for complex patients, poorly understood conditions, and/or costly conditions.

The purpose of this study was to estimate, on a national level, how using a practice-based EHR relates to PCP opioid analgesic prescribing for patients without cancer, including patients with chronic non-cancer pain. Despite the fact that PCPs treat approximately 52 % of patients with chronic pain, PCPs report significant discomfort with [10, 11] and minimal training in pain assessment and management [12]. Furthermore, prescription opioid abuse, misuse, and diversion are part of a national epidemic [13], while chronic pain costs the nation an estimated $635 billion annually in health care expenses and lost worker productivity [14]. And, longitudinal studies suggest physicians often rely on guideline discordant pain treatments [15]. While prior studies describe the development and evaluation of diagnostic decision support for pain conditions [16–18] and performance feedback systems for anesthesiologists [19], to our knowledge, researchers have not

examined how general EHR use relates to prescribing decisions for pain. Presumably, PCPs with EHRs should be better equipped to handle the challenges of managing pain and opioids. For example, EHRs may help PCPs collect, organize, and monitor the large volume of patient information they need for patients with pain, such as imaging results, mental health history, medication history, and treatment outcomes. With this information, PCPs could better target opioid therapies for patients that are likely to benefit and avoid prescribing opioids to patients at risk of abuse, misuse, or diversion. Also, EHRs could accommodate PCPs who have minimal training or experience with pain by providing automated care protocols, decision support, and electronic communication with pain specialists.

Therefore, to estimate how EHRs actually relate to opioid prescribing, we analyzed a nationally representative sample of PCP visits from the 2007–2010 National Ambulatory Medical Care Survey (NAMCS). Using this data, we compared the likelihood that patients receive an opioid prescription during visits to physicians with EHRs versus physicians without EHRs.

Methods

Data source

This cross-sectional study used data from the 2007–2010 National Ambulatory Medical Care Surveys (NAMCS) [20]. The NAMCS is an annual survey of physicians conducted by the National Center for Health Statistics and is frequently used to assess national patterns in office-based care [7, 21, 8, 15, 9]. The survey uses a probability sampling design to provide a nationally representative sample of patient visits to non-federal office-based practices [22]. Trained interviewers visit and instruct physicians on how to participate each year. Physicians or members of their office staff then complete a standardized encounter form for a random sample of patient visits occurring over a 1 week reporting period. The encounter form collects information including patients' demographics, symptoms, reason for visit, diagnoses, medications, and treatment. Physicians also report individual and office-level information including details on their specialty, electronic health record system, ownership structure, and patient population. The NAMCS procedures and data are described in detail elsewhere [23]. The University of Florida Institutional Review Board (IRB) approved the research protocol.

Data and statistical analysis

We conducted a cross-sectional analysis of adult primary care visits in the 2007–2010 NAMCS surveys [20]. Specifically we included all visits to an internal medicine or family/general practice physician by patients eighteen years or older who did not have a cancer diagnosis (N=33,090). We excluded visits for patients with a cancer diagnosis because opioid prescribing is generally more accepted among patients with malignant pain. In addition to analyzing the full sample of adult primary care visits, we conducted sub-analyses of patients without prior visits to the treating PCP (n=4,870) and patients whose visits were specifically for a common chronic pain condition, including headache pain, arthritis pain, or musculoskeletal pain (n=2,473). We included visits by new patients because EHRs could

help a PCP more quickly obtain additional medical information and assess a patient without a prior visit history. We included visits by patients with chronic pain conditions because chronic pain management is particularly challenging to PCPs and an area where EHRs could help them obtain a more complete understanding and assist with monitoring and management of these complex patients.

We used receipt of an opioid prescription as our primary outcome variable. NAMCS uses the Multum Lexicon Plus system to classify drugs that were prescribed during recorded visits [24]. Using this classification system, we identified all visits in our sample that resulted in a prescription of buprenorphine, butorphanol, codeine, dihydrocodeine, fentanyl, hydrocodone, hydromorphone, meperidine, methadone, morphine, nalbuphine, naloxone, oxycodone, oxymorphone, pentazocine, propoxyphene, tapentadol, or tramadol. We included opioid agonists, antagonists, and agonist/antagonists as well as tramadol for consistency with prior studies of opioid prescribing patterns using NAMCS data [25, 26]. Our primary independent variable was physicians' use of an EHR system in their practice. We identified physicians with EHRs using the NAMCS question that asks "Does the reporting location use an electronic medical record (EMR) or electronic health record (EHR) system? Do not include billing record systems." We identified only physicians that responded "Yes, all electronic" as EHR physicians. We identified physicians that responded "Yes, part paper and part electronic," "No," or "Unknown" as non-EHR physicians. As independent variables for secondary analyses, we identified physicians that reported using specific electronic system functions, including electronic demographics, electronic lab results, electronic prescribing, electronic clinical notes, electronic image viewing, electronic test orders, and electronic clinical reminders.

We used logistic regression to compare the odds of an opioid prescription among visits with EHR physicians versus non-EHR physicians. First, we regressed a binary variable indicating receipt of an opioid on the binary variable indicating an EHR physician. In subsequent models, we controlled for observable differences between visits to EHR physicians and non-EHR physicians using a logistic regression approach with propensity score covariates. For each model, we computed the propensity of a visit being with an EHR-physician using a logistic regression model that regressed the EHR indicator on a set of practice and physician characteristics we judged to be conceptually related to physicians' EHR use. These variables included practice ownership status, solo versus multi-physician practice, geographic region, urban–rural location, year of encounter, and payer. To add additional information to the propensity score estimate that was otherwise unobserved, we also included the NAMCS survey weight as a covariate in the propensity score model [27]. Next, for each of the primary regression models, we regressed receipt of an opioid prescription on the EHR indicator, dummy variables corresponding to decile categories of the propensity score estimate, and a set of visit, patient, and practice characteristics. These characteristics included visit information (year, payer, physician time spent with patient, dummy variable for chronic pain as reason for visit, dummy variable for non-chronic pain as reason for visit), patient information (age, sex, race, new versus established patient, dummy variables for specific comorbid conditions, zip code, median income), and practice information (practice ownership status, solo versus multi-physician practice, geographic region, urban–rural location). For robustness, we tested alternate specifications including computing the

propensity score based on all visit, patient, and practice characteristics and including the continuous propensity score estimate in the final regressions rather than the decile categories.

In the secondary analyses, we conducted similar regressions except that we replaced the EHR indicator variable with indicator variables indicating the presence of the specific electronic system functions. These secondary analyses focused specifically on patients whose visits were for chronic pain conditions.

To account for the NAMCS' probability sampling strategy and to allow for the estimates to be nationally-representative, we used the survey procedures in STATA version 10 [28] in the regressions that modeled the relationship between opioid prescribing and EHR or other electronic functionality use. We calculated both odds ratios and marginal effects at the sample means. Marginal effects at the sample means represent the difference in the probability of an outcome occurring between a given category and the reference group for an observation at the sample mean for all variables [29]. We judged statistical significance at the $P<0.05$ level.

Results

EHR and opioid prescriptions

Thirty-five percent of the visits analyzed were to physicians with a fully electronic EHR system. Moreover, 10 % of all visits were for non-chronic pain conditions, while 7 % were for chronic pain conditions (Table 1). And, 13 % of all visits resulted in an opioid prescription, while 33 % of visits for chronic pain resulted in an opioid prescription. Patients in our sample averaged 54 years of age, and 60 % were women (Table 2). Tables 1 and 2 further describe the visit, practice, and patient characteristics of the study sample.

Analysis indicated that 11.6 % of visits to physicians without an EHR resulted in an opioid prescription. And, a significantly higher proportion, 13.9 %, of visits to physicians with an EHR resulted in an opioid prescription ($P=0.01$). Furthermore, after controlling for visit, patient, and practice characteristics (Table 3), physicians with EHRs had 1.38 times the odds of prescribing an opioid compared to physicians without EHRs (95 % CI, 1.22–1.56; $P<0.001$). Among the 4,870 visits by new patients, physicians with EHRs were also more likely to prescribe opioids but the adjusted odds ratio (adj. OR) was not statistically significant (adj. OR=1.42, 95 % CI, 0.97–2.08; $P=0.07$). However, among the 2,473 visits involving a chronic pain condition, physicians with EHRs did have significantly higher adjusted odds of prescribing an opioid (adj. OR=1.39, 95 % CI 1.03–1.88, $P=0.03$).

Specific EHR functionalities and opioid prescriptions

Among patients with chronic pain reasons for visiting a physician, opioid prescribing was associated with two out of seven specific EHR functionalities analyzed. After controlling for visit, patient, and practice characteristics (Table 4), physicians with electronic clinical notes had 1.51 times the odds of prescribing an opioid compared to physicians without electronic clinical notes (95 % CI, 1.10–2.05; $P=0.01$). Also, visits to physicians with electronic test

orders were more likely to result in opioid prescriptions compared to physicians without electronic test orders (adj. OR=1.31, 95 % CI, 1.01–1.71; *P*=0.04).

Discussion

This study aimed to understand, on a national level, how using EHRs in primary care relates to opioid analgesic prescribing for adult patients without cancer. EHRs offer a potential means for PCPs to more fully and accurately assess complex patients, such as those with pain, and to make challenging decisions [4, 1, 30, 31], such as when to prescribe opioids [32]. The primary finding of this study was that visits to physicians with EHRs were more likely to result in opioid prescriptions than visits to physicians without EHRs. We observed this relationship both for non-cancer related visits generally and for visits for chronic non-cancer pain. Assuming that a full-time PCP sees an average of 90 patients per week, the observed differences reflect approximately two additional opioid prescriptions per week per PCP.

This study showed a national increase in opioid prescribing among primary care physicians with EHRs compared to those without EHRs. This relationship naturally leads to the question of whether or not EHR use is related to better or worse patient care. On one hand, physicians with EHRs could be providing more appropriate pain relief, perhaps because they are better equipped with the information they need to manage complex patients. On the other hand, physicians with EHRs could simply be prescribing more medications with significant risk without a corresponding health benefit. Unfortunately, this study cannot judge whether or not increased opioid prescribing among physicians with an EHR is resulting in better or worse patient care. However, the primary implication of this study is that similar visits to physicians with and without EHRs are resulting in fundamentally different treatment decisions. Such national-level differences have rarely been shown in prior literature. Therefore, these results underscore the need for researchers and EHR designers to better understand current factors in EHR adoption as well as to employ user-centered approaches to developing and evaluating clinical information technology [33, 34]. For example, researchers and EHR designers should work closely with primary care clinicians to understand their work processes and clinical decision making to ensure that systems predictably influence decisions and positively impact care quality and outcomes. Without these efforts, the ongoing adoption and use of EHRs could lead to unexpected clinical decisions and unintended negative consequences [35–37].

This study also found that chronic pain visits to physicians with electronic clinical notes or electronic test orders were more likely to result in opioid prescriptions than visits to physicians without these functionalities. These results stood out in that other specific electronic functionalities, such as electronic demographics, lab results, and prescribing, did not relate to differences in opioid prescribing. While we are cautious to ascribe causal relationships, these relationships may suggest that electronic clinical notes or test orders provide utility in helping physicians obtain the information they need to feel confident in safely prescribing and monitoring opioids. Regardless of the underlying mechanism, these findings further suggest the need for new research that closely examines clinical work and decision making in the context of EHRs and related electronic functionality. Such research

is critical to understand how physicians use EHRs and their different features when making challenging decisions, such as choosing whether or not to prescribe opioids.

This study has some limitations that should be mentioned. First, this is a cross-sectional study, so we cannot say that EHR use is causally related to opioid prescribing. It is possible that practices that are equipped with EHRs see a different spectrum of patients, that those differences were not captured by the variables in our analyses, and that those differences account for the differences in opioid prescribing patterns. Similarly, unobserved differences in physicians that are related both to EHR adoption and to opioid prescribing could have led to the observed results. With that said, we did control for a number of visit, practice, and patient level characteristics to minimize the influence of unobserved confounding in our analyses. To further reduce confounding, we also adjusted our regression estimates using propensity scores. However, even with the propensity score adjustment, we could not adjust for unobserved differences that may exist among physicians and their visits. In addition, as described above, this study was not able to differentiate between clinically appropriate (e.g., high benefit and low risk) opioid prescriptions versus clinically inappropriate opioid prescriptions. Indeed, such a determination is difficult to make even with more extensive data than is available in the NAMCS. Future research should seek to understand whether using EHRs or specific electronic functionalities actually cause more appropriate opioid prescribing decisions.

In conclusion, this study provides the first evidence relating EHR use to opioid prescribing in primary care. Moreover, this study is one of few to demonstrate a national level relationship between EHR use and management of a prevalent and complex primary care problem. Today, primary care clinicians are increasingly using EHRs while also grappling with how to efficiently, safely, and effectively manage pain and other chronic conditions. Therefore, clinical researchers must continue to identify and elucidate the relationship between these concurrent trends in technology and primary care. By understanding these relationships, EHR designers can prospectively develop more usable and useful systems that help clinicians obtain the right patient information at the right time and thus produce safer and more effective patient care.

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Table 1

Visit and practice characteristics of primary care office visits with and without electronic health records

	Visits to practices without EHRs (*N*=21,501)	Visits to practices with EHRs (*N*=11,589)
Visit characteristics		
Pain reason for visit, non-chronic (%)	10.0	10.7
Pain reason for visit, chronic (%)	7.8	6.8
2007 (%) (ref)	30.4	14.6
2008 (%)	26.2	24.0
2009 (%)	24.8	29.9
2010 (%)	18.6	31.5
Medicare (%)	27.3	25.1
Medicaid (%)	9.3	5.8
Private payer (%) (ref)	50.9	58.1
Other payer (%)	9.8	5.8
Unknown payer (%)	2.6	5.2
Spending 0 min with physician (%)	3.4	2.4
Spending 1–15 min with physician (%)	54.4	49.6
Spending 16–35 min with physician (%)	36.6	41.3
Spending 35+ minutes with physician (%) (ref)	5.5	6.7
Practice characteristics		
In metropolitan statistical area (%)	83.1	88.1
Physician owned (%) (ref)	81.2	65.0
Community health center owned (%)	5.4	4.6
Other ownership (%)	13.4	30.4
Solo practice (%)	41.1	20.3
Midwest U.S. (%)	23.0	27.7
Northeast U.S. (%) (ref)	16.3	17.9
South U.S. (%)	42.6	30.9
Western U.S. (%)	18.1	23.6

Frequencies are from NAMCS 2007–2010 survey and are weighted estimated based on survey sample weights. Only visits for patients 18 years and older and without cancer are included. Common pain conditions identified based on physician reported reason for visits as chronic arthritis, headache pain and/or musculoskeletal pain. Categories that were modeled as reference group in subsequent regressions are indicated by (ref).

Table 2

Patient characteristics of primary care office visits to practices with and without electronic health records

	Visits to practices without EHRs (*N*=21,501)	Visits to practices with EHRs (*N*=11,589)
Patient characteristics		
Age	53.8	53.7
Male (%)	40.2	40.9
White (%) (ref)	81.9	84.5
Black (%)	13.0	10.4
Other race (%)	5.1	5.1
Median zip code income quartile 1 (%)	23.3	17.0
Median zip code income quartile 2 (%)	21.9	24.8
Median zip code income quartile 3 (%)	23.9	22.8
Median zip code income quartile 4 (%) (ref)	26.1	27.1
Missing income quartile (%)	4.8	8.3
0 prior visits to this physician (%)	13.2	14.4
1–3 prior visits to this physician (%)	43.3	44.2
3+ prior visits to this physician (%) (ref)	43.6	41.4
Arthritis (%)	16.7	14.7
Asthma (%)	6.0	6.9
Cerebrovascular disease (%)	2.1	1.9
Congestive heart failure (%)	2.3	2.4
Chronic obstructive pulmonary disease (%)	7.0	5.2
Depression (%)	11.6	15.1
Diabetes (%)	16.7	18.1
Hyperlipidemia (%)	25.8	32.4
Hypertension (%)	39.1	39.9

Frequencies are from NAMCS 2007–2010 survey and are weighted estimated based on survey sample weights. Only visits for patients 18 years and older and without cancer are included. Categories that were modeled as reference group in subsequent regressions are indicated by (ref).

Table 3

Association between electronic health record use and opioid prescribing in primary care visits

	N	Visits receiving opioid without an EHR	Visits receiving opioid with an EHR	Adjusted OR[a] (95 % CI)	Adjusted *P*-value[a]	Marginal effect[a]
All visits	33,090	11.6 %	13.9 %	1.38 (1.22–1.56)	<0.001	3.1 %
Visits by new patients	4,870	8.4 %	10.1 %	1.42 (0.97–2.08)	0.07	2.6 %
Visits for common chronic pain conditions	2,473	31.7 %	36.4 %	1.39 (1.03–1.88)	0.03	7.4 %

Abbreviations: *OR* odds ratio. Data are for patients 18 years or older with no cancer diagnosis.

[a]Estimates are based on logistic regression of opioid receipt on EHR use indicator, controlling for decile of propensity score and individual visit, patient, and practice characteristics (see Tables 1 and 2), weighted by NAMCS sample weights.

Table 4

Association between individual electronic functionalities and opioid prescribing in primary care visits for chronic pain

	Visit receiving opioid without functionality present	Visit receiving opioid with functionality present	Adjusted OR[a] (95 % CI)	Adjusted *P*-value[a]	Marginal effect[a]
Demographics	31.3 %	33.8 %	1.16 (0.74–1.80)	0.52	3.2 %
Lab results	34.1 %	32.7 %	0.96 (0.71–1.29)	0.77	−1.0 %
Prescription ordering	33.6 %	33.0 %	1.03 (0.78–1.37)	0.82	0.7 %
Clinical notes	30.5 %	36.6 %	1.51 (1.10–2.05)	0.01	9.2 %
Image viewing	33.7 %	32.8 %	1.00 (0.71–1.40)	0.999	0.02 %
Test orders	31.8 %	35.3 %	1.31 (1.01–1.71)	0.04	6.1 %
Clinical reminders	33.6 %	32.8 %	1.15 (0.87–1.52)	0.32	3.2 %

Abbreviations: *OR* odds ratio. Data are for patients 18 years or older with no cancer diagnosis and a common chronic pain condition reason for visit

[a]Estimates are based on logistic regression of opioid receipt on electronic functionality indicator, controlling for decile of propensity score and individual visit, patient, and practice characteristics (see Tables 1 and 2), weighted by NAMCS sample weights. *N*=2,473 for each model.