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Original Research Article

Factors Associated with Opioid Dose Increases: A Chart Review of Patients' First Year on Long-Term Opioids

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Abstract

Objective. To examine encounter-level factors associated with opioid dose increases during patients' first year on opioid therapy for chronic pain.

Design. Case-control study analyzing all opioid prescriptions for patients with chronic pain during their first year after opioid initiation. Cases were patients who experienced an overall dose escalation of ≥ 30 mg morphine equivalents over the 1-year period; controls did not experience overall dose escalation. Main measures were encounter type, opioid dose change, documented prescribing rationale, documentation of guideline-concordant opioid-prescribing practices. Two coders reviewed all encounters associated with opioid prescriptions. Analysis of factors associated with dose increases and provider documentation of prescribing rationale was conducted using multiple logistic regression.

Results. There were 674 encounters coded for 66 patients (22 cases, 44 controls). Fifty-three percent of opioid prescriptions were associated with telephone encounters; 13% were associated with e-mail encounters. No prescribing rationale was documented for 43% of all opioid prescriptions and 25% of dose increases. Likelihood of dose increase and documentation of prescribing rationale did not significantly differ for cases versus controls. Compared with face-to-face encounters, dose increases were significantly less likely for telephone (OR 0.18, 95% CI 0.11–0.28) and e-mail (OR 0.23, 95% CI 0.12–0.47) encounters; documentation of prescribing rationale was significantly more likely for e-mail (OR 5.06, 95% CI 1.87–13.72) and less likely for telephone (OR 0.30, 95% CI 0.18–0.51) encounters.

Conclusion. Most opioid prescriptions were written without face-to-face encounters. One quarter of dose increases contained no documented prescribing rationale. Documented encounter-level factors were not significantly associated with overall opioid dose escalation.

Key Words. Chronic Pain; Opioids; Communication; Medical Decision Making; Physician Practice Patterns

Introduction

Although opioid prescription rates show signs of stabilizing [1], the dramatic increase in opioid prescribing during recent decades has led to a tripling of opioid-related overdose deaths between 2000 and 2014 [2–4] Evidence supporting the effectiveness of opioid analgesics for treating chronic noncancer pain is equivocal [5], though risk factors for opioid-related harm and opioid misuse have been increasingly well documented. High-dose opioid use (greater than 80–100 morphine equivalents per day) [6,7] in particular has been consistently associated with increased risk of opioid-related overdose and death [6,8].

Patient and dose-related risk factors are important correlates of opioid-related harm, but opioid prescriptions are written by providers one patient encounter at a time. Little is known about how providers make decisions about opioid dosing (i.e., to continue, increase, or decrease a patient's dose) when they write individual prescriptions. Prior studies examining risk factors for high-dose opioid use and opioid misuse have found that documentation of guideline-concordant practices for safe opioid prescribing is poor [9–13]; however, neither providers' rationale for individual opioid prescriptions nor encounter-level factors associated with opioid dose increases have been previously studied.

To address this gap, we conducted a nested case-control study to identify encounter-level factors associated with both 1) encounter-level opioid dose increases (i.e., individual prescriptions) and 2) patients' overall opioid dose escalation (measured as rate of overall dose change) after one year of opioid therapy for chronic pain. We reviewed electronic health record documentation (including providers' prescribing rationale and guideline-concordant prescribing practices) for all opioid prescriptions written during patients' first year of opioid therapy. Our goal was to provide new insights about provider prescribing behaviors that may inform subsequent point-of-care interventions aimed at reducing the incidence of inadvertent or inappropriate opioid dose increases for patients with chronic pain.

Methods

Data Source and Case Identification

Data were extracted from a patient cohort identified using the electronic medical records of an academic health system comprising multiple primary care and specialty clinics in Northern California. The original cohort comprised all opioid-naïve adult ($\geq$18 years old) patients with musculoskeletal pain who received their first opioid prescription between July 1, 2011, and June 30, 2012, then received at least one opioid prescription every 90 days for the following year. This approach excluded patients receiving short-term or intermittent opioid prescriptions and minimized inclusion of patients receiving opioid prescriptions from outside the health system. Opioids not scheduled during the time of the study or used primarily for substance abuse treatment (e.g., buprenorphine) were excluded. Methadone prescriptions were included when used for chronic pain treatment. While no single standard for equianalgesic opioid dose conversion exists, we employed a conversion table that has been widely used in prior studies to calculate mean daily opioid dose in morphine equivalents [14] by quarter and to estimate patients' overall dose escalation over the 1-year period. Patients receiving cancer treatment or palliative care were excluded. Full details of cohort identification have been published previously [15].

For this study, cases were all patients identified from the cohort who experienced an overall escalation in their daily opioid dose of $\geq$30 mg morphine equivalents during their first year on long-term opioids. This cutoff represents a 50–150% increase compared to recommended starting doses for opioid naïve patients [16,17]. For each case, we randomly selected two control patients from the same cohort who did not experience an overall escalation in their daily opioid dose of $\geq$30 mg morphine equivalents over the 1-year period. Classification as case versus control was based solely on patients' overall change in opioid dose during the 1-year study period and not on individual (encounter-level) prescriptions. For example, a case patient could be prescribed an opioid dose decrease during an individual encounter and still experience an overall dose increase over the 1-year study period.

Medical Record Abstraction

Three authors (CB, AC, and SGH) developed a data abstraction form and coding manual to identify encounters associated with opioid prescriptions and other encounter-level characteristics. Authors generated lists of possible opioid-prescribing rationales from clinical experience, applied these lists to two patient records, and then modified these lists to accommodate additional rationales. They continued this iterative process until the abstraction form contained an exhaustive list of possible prescribing rationales. Two authors (CB and AC) independently coded all patient encounters using the final coding manual and chart abstraction tool (available in Supplemental Content 1). Disagreements were resolved by discussion and adjudicated by the senior author when necessary. Intercoder agreement for major encounter-level variables was calculated using Cohen's kappa [18] and was high (0.91 for identifying encounters

associated with opioid prescriptions, 0.80 for encounter type, and 0.73–0.91 for classifying opioid prescriptions).

Measures

Encounter characteristics. The following encounter characteristics were coded for each encounter associated with an opioid prescription: encounter type (e.g., office visit, emergency room visit), chief complaint, and whether the encounter was associated with a primary care clinic. Encounter types were also classified as face-to-face, telephone, or e-mail.

Opioid prescriptions and prescribing rationale. Documented prescribing rationales were coded for all opioid prescriptions. Each prescription was also classified into one of the following categories: 1) new opioid prescription, 2) routine refill without dose change, 3) dose increase, or 4) dose decrease. To the extent possible, classification was based on providers' characterization of the prescription during the encounter in order to capture providers' intentions. When documentation characterizing the prescription was not present, prescriptions were classified as dose increases if they involved either an increase in either the number of pills dispensed or the pill strength (e.g., from 5 mg to 10 mg hydrocodone tablets). Changes in pill strength made explicitly to reduce patients' pill burden or total acetaminophen dose were rare and were not classified as dose increases. Analogous rules were used to classify dose decreases. Changes to a different opioid type or formulation (e.g., from hydrocodone to oxycodone or from short-acting to long-acting oxycodone) were classified as new prescriptions. When encounters included two opioid prescriptions, classification of the encounter dose change was determined based on the combination of prescriptions (e.g., an encounter that included a new prescription and a routine refill was classified as a dose increase); ambiguous combinations (e.g., a new prescription and a dose decrease during the same encounter) were rare and were adjudicated by the senior author based on review of the medical record.

Guideline-concordant practices. The presence or absence of the following 10 guideline-concordant practices for safe opioid prescribing was coded for each coded encounter: discussion of functional status; evaluation or treatment for depression, anxiety, and/or illicit substance use (including alcohol); recommendation of nonpharmacologic pain treatments (e.g., physical therapy); discussion of opioid side effects; use of controlled substance agreements; use of prescription drug monitoring programs; use of urine toxicology screens; and referral to a specialist for pain evaluation or management. These practices are recommended by recent clinical practice guidelines [16,19] and have been used in prior studies evaluating guideline-concordant prescribing practices [11,20,21]. We focused on practices aimed at minimizing opioid-related risks and inappropriate prescribing [22]. Recent guidelines suggest that assessment of pain severity may be less important for guiding prescribing decisions in the context of chronic pain [23]. Intercoder agreement for these patient-level variables was calculated using percent agreement because several variables were coded as present for <2 patients and Cohen's kappa is difficult to interpret for rare events [24]. Percent agreement for guideline-concordant practices was 80–98%. We also coded whether encounters included documentation that patients exhibited aberrant drug-related behaviors (e.g., taking more opioids than prescribed, requesting early refills).

Statistical Analysis

Using descriptive statistics, we summarized patient demographics, encounter-level characteristics, encounter-level dose change, and frequency of different documented prescribing rationales for cases and controls.

To identify encounter characteristics associated with encounter-level opioid dose increases, we performed multiple logistic regression with encounter-level opioid dose increase as the dependent variable and encounter type (face-to-face, phone, or e-mail), presence of any documented prescribing rationale, primary care encounter status, and patient group (i.e., case or control) as independent variables.

We noticed that a substantial proportion of encounters contained no documented prescribing rationale, so we also conducted exploratory analyses to identify factors associated with presence of any documented prescribing rationale. Documentation was considered present if at least one prescribing rationale (other than a pharmacy-initiated refill request) was coded for any opioid prescription associated with that encounter. We then performed logistic regression with presence of any documented prescribing rationale as the dependent variable and interaction type, encounter-level dose change, primary care encounter status, and patient group as independent variables.

For both regression analyses, we used mixed effects logistic regression to account for encounters being nested within patients. We also excluded the encounters during which patients received their first opioid prescription, because an initial prescription was required for inclusion in our sample. Regression assumptions were checked by evaluating observed-expected tables.

Finally, we compared frequency of guideline-concordant practices for cases versus controls. To account for the reality that busy clinicians may not always fully document pain management practices at every visit, each practice was considered present for a patient if it was documented for that patient at least once any time during the 1-year study period. We created an overall score (range 0–10) for each patient and compared the scores of cases and controls using a two-sample t-test. This approach has been used in prior studies of guideline-concordant practices [11,12]. Separately, we also

examined the frequency of documented aberrant drug-related behaviors for cases and controls.

Results

Our cohort contained 22 case patients and 44 randomly selected control patients for a total sample of 66 patients. Mean overall escalation in daily opioid dose during the study period was 66 mg morphine for cases versus 2 mg for controls. Patients were 47% men; mean age was 53. Patient race was 73% white, 10% black, 3% Asian, 2% Hawaiian/Pacific Islander, and 12% other; 13% were Hispanic. Further details of patient characteristics, including patient comorbidities, have been previously published in the parent cohort study [15]. A total of 674 encounters for these 66 patients involved opioid prescriptions and were coded. Eleven prescriptions documented in the medical record had no associated encounter. Hydrocodone-acetaminophen was the most common opioid prescribed and accounted for 77% of all prescriptions.

Encounter characteristics. Table 1 describes encounter characteristics for cases and controls. Telephone encounter was the most common encounter type in both groups (47% for cases, 57% for controls), followed by office visits and e-mail encounters. Cases had a notably higher proportion of e-mail encounters (17%) than controls (9%). In addition, cases had many more encounters overall; the mean number of opioid-related encounters over the 1-year study period was 13.5 for each case patient and 8.8 for each control. The majority of encounters were associated with primary care clinics (85% for cases; 89% for controls). All e-mail encounters were associated with primary care clinics. The chief complaint for most encounters was a medication refill request in both groups. Excluding patients' first prescriptions, 32% of encounters for case patients resulted in dose increases compared with 22% for controls.

Opioid-prescribing rationale. Fifty-seven percent of all encounters (66% of cases; 51% of controls) contained at least one documented rationale for the opioid prescription associated with that encounter. Pharmacy-initiated refill requests were not counted as a documented rationale. Table 2 shows the frequency of different prescribing rationales documented for opioid prescriptions classified as dose increases. Thirty-six percent of dose increases for cases and 51% for controls had no documented prescribing rationale. The most frequent documented rationale was inadequate pain relief (29% for cases; 17% for controls). One notable difference between groups was that 11% of dose increases for cases involved patient-initiated dose escalation compared with 2% of dose increases for controls. For prescriptions classified as routine refills, the most common prescribing rationale was patient request. Nearly half of the routine refills for controls and 36% of the routine refills for cases had no associated prescribing rationale documented. Complete results of prescribing rationales documented for routine refills, dose decreases, and new opioid prescriptions are available online (see tables in Supplemental Content 2 for full coding results).

Encounter types. The majority of all opioid prescriptions (53%) in our sample were written as a result of

Table 1 Encounter characteristics by patient group

	Controls ($n = 381$)	Cases ($n = 293$)
Encounter type, *n* (%)		
Telephone	216 (56.7%)	137 (46.8%)
Office visit	109 (28.6%)	84 (28.7%)
E-mail	35 (9.2%)	50 (17.1%)
Hospital/procedure discharge	12 (3.2%)	16 (5.5%)
Emergency department	3 (0.8%)	1 (0.3%)
No documentation, other	6 (1.6%)	5 (1.7%)
Chief complaint, *n* (%)		
Medication refill request	22 (59.1%)	168 (57.3%)
Pain-related physical complaint	116 (30.5%)	97 (33.1%)
Non–pain-related physical complaint	29 (7.6%)	14 (4.8%)
Other/cannot determine	11 (2.9%)	14 (4.8%)
Primary care encounter,* *n* (%)	335 (89.3%)	244 (84.7%)
Overall encounter dose change**, *n* (%)		
Dose decrease	27 (8.0%)	25 (9.2%)
No change in dose	235 (69.7%)	160 (59.0%)
Dose increase	75 (22.3%)	86 (31.7%)

*Values missing for 11 encounters (6 for controls, 5 for cases) with no associated documentation.
**Patients' first opioid prescriptions are omitted from this category because a new opioid prescription was required for inclusion in the study sample.

Table 2 Documented rationale for opioid prescriptions resulting in dose increase*

	Controls ($n = 59$)	Cases ($n = 66$)
No rationale documented, %	50.8	36.4
Inadequate pain relief, %	16.9	28.8
Change in pain severity or location, %	15.3	15.2
Patient requested increased dose, %	10.2	12.1
Dose increased to reflect patient's self-increased dose, %	1.7	10.6
Post-procedure related pain, %	10.2	10.6
Tolerance, %	0	4.6
Other, %	1.7	9.1

*Categories are not mutually exclusive.

telephone encounters, 13% were written as a result of e-mail encounters, and 34% were written as a result of face-to-face interactions (e.g., office or emergency department visits). As shown in Table 3, most prescriptions associated with telephone encounters did not involve any change in dose. Not counting patients' first prescriptions, 59% of dose increases were associated with face-to-face interactions, 31%, with telephone encounters, and 10% with e-mail encounters.

Statistical analysis. Table 4 shows multivariable analysis results for factors associated with opioid dose increases at the individual encounter level. Compared to encounters that involved face-to-face interactions, providers were significantly less likely to increase patients' opioid dose as a result of e-mail (OR 0.23, 95% CI 0.12–0.47, $P < 0.001$) or telephone (OR 0.18, 95% CI 0.11–0.28, $P < 0.001$) encounters. Case patients had a greater proportion of encounters than controls that resulted in dose increases, but this difference was not quite statistically significant after adjusting for other independent variables (OR 1.59, 95% CI 0.99–2.57, $P = 0.055$). Neither primary care encounters nor documentation of prescribing rationale was associated with opioid dose increases.

Table 5 summarizes the results of the analysis examining factors associated with presence of any documented prescribing rationale. Compared to encounters involving face-to-face interactions, providers were significantly more likely to document some prescribing rationale for e-mail interactions (OR 5.06, 95% CI 1.87–13.72, $P = 0.001$) and significantly less likely to document prescribing rationale for telephone interactions (OR 0.30, 95% CI (0.18–0.51, $P < 0.001$). After controlling for other variables, opioid dose changes at the encounter level were not significantly associated with the presence of any documented prescribing rationale. Similarly, neither primary care encounters nor patient group (i.e., case versus control) were significantly associated with documentation of prescribing rationale.

Guideline concordant practices. Table 6 shows the frequency of documented guideline-concordant prescribing practices by patient group. The mean number of guideline-concordant practices was significantly higher for cases than for controls (3.9 versus 2.4, $P < 0.001$). All practices except anxiety assessment were more common for cases than controls. A urine toxicology screen was ordered for only one patient; we found no documentation that prescription drug monitoring programs were consulted for any patient. Documentation of aberrant drug-related behaviors was present in 1.8% of all encounters (2.7% for cases; 1.1% for controls). Twenty-seven percent of case patients had at least one aberrant behavior documented, compared with 9% in the control group.

Table 3 Encounter opioid dose change stratified by encounter type*

	Telephone	Face-to-face	E-mail
Dose decrease ($n = 50$)	23 (6.9%)	21 (11.8%)	6 (7.1%)
No change in dose ($n = 391$)	264 (78.6%)	65 (36.5%)	62 (73.8%)
Dose increase ($n = 157$)	49 (14.6%)	92 (51.7%)	16 (19.1%)

*Patients' first opioid prescriptions are omitted.

Discussion

We conducted a nested case-control study to investigate encounter-level factors associated with individual

Table 4 Factors associated with encounter-level opioid dose increases, $n = 598$ encounters*

	Unadjusted OR	95% CI	Adjusted OR	95% CI
Encounter type				
Face-to-face	Ref	–	Ref	–
Telephone	0.16	0.10–0.24	0.18	0.11–0.28
E-mail	0.23	0.17–0.44	0.23	0.12–0.47
Primary care encounter**	0.33	0.19–0.58	0.65	0.36–1.17
Prescribing rationale documented	1.45	0.96–2.17	1.10	0.70–1.73
Patient group				
Controls	Ref	–	–	–
Cases	1.77	1.08–2.90	1.59	0.99–2.57

Abbreviations: OR odds ratio, CI confidence interval, Ref reference group.
*Patients' first prescription encounters are excluded from this analysis because an initial opioid prescription was required for inclusion in the study sample. Adjusted odds ratios are adjusted for all listed independent variables and for clustering of encounters within patients.
**Reference is non–primary care encounter.

Table 5 Factors associated with presence of any documented rationale for opioid prescribing, $n = 598$ encounters*

	Unadjusted OR	95% CI	Adjusted OR	95% CI
Encounter type				
Face-to-face	Ref	–	Ref	–
Telephone	0.30	0.18–0.48	0.30	0.18–0.51
E-mail	5.00	1.89–13.21	5.06	1.87–13.72
Primary care encounter**	0.74	0.38–1.44	0.83	0.51–1.69
Overall encounter dose change				
Dose decrease	0.61	0.30–1.24	0.46	0.21–1.03
No change	Ref	–	–	–
Dose increase	1.36	0.86–2.16	0.99	0.58–1.67
Patient group				
Controls	Ref	–	–	–
Cases	2.14	0.94–4.84	1.80	0.81–4.0

Abbreviations: OR = odds ratio; CI = confidence interval; Ref = reference group.
*Patients' first prescription encounters are excluded from this analysis because an initial opioid prescription was required for inclusion in the study sample. Adjusted odds ratios are adjusted for all listed independent variables and for clustering of encounters within patients.
**Reference is non–primary care encounter.

Table 6 Frequency of documentation for guideline-concordant pain management practices by patient group

Activity	Controls ($n = 44$)	Cases ($n = 22$)
Assessment of functional status,%	70.5	95.5
Discussion of nonpharmacologic treatment,%	63.6	77.3
Referral to pain specialist,%	29.5	54.5
Discussion of opioid adverse effects,%	22.7	63.6
Assessment or treatment of depression,%	13.6	36.4
Assessment or treatment of substance abuse,%	20.5	22.7
Assessment or treatment of anxiety,%	13.6	13.6
Documentation of controlled substance agreement,%	6.8	18.2
Urine toxicology screen ordered,%	0	4.5
PDMP* report checked,%	0	0
Overall guideline score, mean (SD)	**2.4 (1.6)****	**3.9 (1.7)****

*PDMP = prescription drug monitoring program.
**$P < 0.001$ for two-sample t-test for group differences.

opioid dose increases and to compare patients with versus without escalation in their daily opioid dose (defined as ≥ 30 mg morphine equivalents) during their first year on opioids for chronic pain. This study is the first to investigate opioid prescribing patterns and providers' documented rationale for individual encounters and complements findings from prior studies that have focused on patient factors associated with dose escalation over time [8,25].

We found that a majority of all opioid prescriptions resulted from telephone encounters and that about one in eight prescriptions resulted from e-mail encounters. Over 40% of opioid dose increases were prescribed without a face-to-face interaction. In addition, this study showed that only 57% of all encounters resulting in an opioid prescription and 68% of encounters resulting in an opioid dose increase had any prescribing rationale documented in the medical record. In multivariable analyses, presence of documented prescribing rationale was not significantly associated with changes in opioid dosing (Table 5). Although not definitive, our findings that a high proportion of opioid prescriptions and dose increases are written without face-to-face interaction and without any documented rationale are consistent with the hypothesis that providers who prescribe chronic opioids may not always make deliberate decisions to increase patients' daily opioid dose or to transition patients onto long-term opioid treatment [14].

Although cases were defined based on overall dose escalation over 1 year, the difference in the proportion of individual encounters resulting in a dose increase for cases versus controls was not statistically significant. However, case patients had on average 5.7 more opioid-related encounters overall than control patients, so the observed difference in proportions translates into a mean of 3.9 encounter dose increases over the year

for case patients, compared with only 1.7 for controls. Thus, the difference in total number of encounters during the study period likely accounts for the clinically meaningful difference in overall dose escalation during the first year of opioid therapy between cases and controls.

We also found that interaction type was associated with opioid dose increases. Providers were significantly more likely to increase opioid doses after face-to-face interactions than after e-mail or telephone encounters. One possible contributing factor is that nonverbal behaviors related to pain associated with opioid prescribing (e.g., guarding) [26] may only be conveyed in face-to-face interactions. Additionally, performance measures such as patient satisfaction may pressure providers to acquiesce to patient requests for dose increases [27]. Of course, this association does not necessarily imply causation. For example, some providers and clinics may have policies that discourage opioid dose increase without a face-to-face evaluation.

Adequate provider documentation is an essential component of guideline-concordant care and is considered part of "universal precautions" for opioid prescribing [7,22]. In addition to finding a substantial proportion of all prescriptions and dose increases had no associated documented prescribing rationale, our study highlights other associations that might inform policy changes aimed at improving provider documentation. For example, we found that provider documentation of any opioid-prescribing rationale was significantly associated with encounter type. Compared to face-to-face visits, providers were significantly more likely to document their prescribing rationale for e-mail encounters and significantly less likely to do so for telephone encounters. A likely explanation for this finding is that e-mail encounters, unlike telephone encounters, entail written communication that is automatically added to patients' electronic medical records. Given this finding, e-mail encounters may be a preferable alternative to telephone encounters when writing opioid prescriptions outside of face-to-face encounters.

We also found that providers documented significantly more guideline-concordant practices for cases than for controls; this finding is consistent with prior studies showing that documentation is greater for patients on high versus low-dose opioids [8,11]. Providers' clinical impression of patients' risk for opioid misuse and adverse effects depends on many factors not easily abstracted from medical records, so the difference in documentation between cases and controls may indicate that providers are more likely to follow guidelines (or are more likely to document guideline-concordant practices) for patients they perceive as high risk. One guideline that was not documented for any patient in either group was utilization of prescription drug monitoring program (PDMP) reports. This observation is consistent with the finding that PDMP registration and use among registered providers is low across the US [28]. Similarly, only one patient between both groups had any documentation that a urine drug screen was utilized, consistent with prior work that found providers infrequently order urine drug screens, though more recent studies show this may be improving [9,10,29].

An important implication of our study is that encounter-level interventions may have potential to decrease inappropriate or inadvertent opioid dose escalation over time. For example, limiting opioid prescriptions written in response to telephone requests may reduce unnecessary transitions to long-term opioid therapy. Also, promoting e-mail (rather than telephone) for opioid-related communication outside of clinic visits may improve documentation of opioid-prescribing rationale and so reduce inadvertent or inappropriate opioid prescriptions.

Although data analyzed in our study are relatively recent (2011–2013), the opioid-prescribing landscape has changed since our study was conducted. Policymakers, public health officials, and new clinical guidelines have all placed much greater emphasis on reducing opioid-related overdoses and curbing high-risk opioid prescribing. Several important policy shifts have occurred since the end of our study. For example, in October 2014, hydrocodone was reclassified from Schedule III to Schedule II, and tramadol was reclassified to Schedule IV [30–32]. After these changes, prescriptions containing hydrocodone decreased significantly [33]. A majority of prescriptions in our study were associated with telephone encounters, and hydrocodone (which was Schedule III during our study) was the most common opioid prescribed. Because Schedule II medications typically cannot be prescribed over the telephone, our findings suggest that the drop in hydrocodone prescriptions observed after reclassification was due largely to a decrease in prescriptions associated with telephone encounters. Future studies might address how rescheduling hydrocodone has influenced provider documentation and opioid dose escalation. In addition, California has passed a law that will require mandatory PDMP registration starting July 1, 2016, which may result in more frequent use of PDMPs by providers.

Our study has several limitations. Despite coding 674 encounters, our study involved only 66 patients and so had limited statistical power to detect differences between patient groups. Our sample was restricted to patients who stayed on opioids for ≥ 1 year and to one academic health system, so findings may not generalize to other contexts. Clinical documentation is imperfect and is not a comprehensive record of clinical decision making or clinical care. Providers may have provided guideline-concordant care or made thoughtful prescribing decisions without documenting them. However, the large proportion of opioid dose increases written outside of face-to-face encounters and the lack of documentation in nearly one-third of opioid dose increases are concerning given the risks associated with high-dose opioid consumption. As noted above, associations in

our regression analysis do not imply causation and may be confounded by factors not measured in this study.

This study is important because it is the first to investigate opioid prescribing at the level of individual encounters, where most prescribing decisions are made. Our findings related to clinical documentation and interaction type can thus inform future efforts to decrease the incidence of high-dose opioid consumption by preventing inappropriate or inadvertent opioid dose escalation during the first year of long-term opioid therapy.

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