12-9-2020

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Article

Prescribing Habits of Providers and Risk Factors for Nonadherence to Opioid Prescribing Guidelines

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Abstract

Background: The Michigan Opioid Prescribing Engagement Network introduced guidelines in October 2017 to combat opioid overprescription following various surgical procedures. We sought to evaluate changes in opioid prescribing at our academic center and identify factors associated with nonadherence to recently implemented opioid prescribing guidelines.

Methods: This retrospective review analyzed opioid prescribing data for appendectomy, cholecystectomy, and hernia repair from January 2015 through September 2017 (pre-guidelines group) and November 2017 through December 2018 (post-guidelines group). October 2017 data were excluded to allow for guideline implementation. Opioid prescribing data were recorded as total morphine equivalents (TMEs).

Results: Of 1493 cases (903 pre-vs. 590 post-guidelines), the mean TME prescribed significantly decreased post-guidelines (231.9 ± 108.6 vs. 112.7 ± 73.9 mg; $P < .01$). More providers prescribed within recommended limits post-guidelines (2.8% vs. 44.8%; $P < .01$). On multivariable analysis, independent risk factors for guideline nonadherence were the American Society of Anesthesiologists class > 2 (adjusted odds ratio [AOR]:1.65, 95% confidence interval[CI] 1.09-2.49; $P = .02$), general surgery vs. acute care surgery service (AOR 1.89, 95% CI 1.15-3.10; $P = .01$), oxycodone vs. hydrocodone (AOR:1.90, 95% CI:1.06-3.41; $P = .03$), and nonphysician provider vs. resident prescriber (AOR:2.10, 95% CI:1.14-3.11; $P < .01$).

Conclusions: Opioid prescribing significantly reduced after the adoption of opioid prescribing guidelines at our institution. Numerous factors associated with provider guideline nonadherence may identify actionable targets to minimize opioid overprescribing further.

Introduction

Despite only representing 4% of the global population, the United States is estimated to consume over 80% of the world's opioids.[1] As opioid prescriptions increased over the past decade, so have the rates of opioid-related drug abuse and overdose deaths.[2-6] At least half of opioid-related deaths are attributed to prescription opioids, which are nearly universally prescribed after surgical procedures.[7-10] Opioid overprescribing has thus been firmly established as one of the main drivers of the opioid epidemic.[11] Nevertheless, despite increased opioid prescriptions over time, most prescription opioids go unused, suggesting inappropriate prescription amounts.[7,12-14] Fear of decreased patient satisfaction scores and increase in pain-related emergency department visits have been proposed as drivers of this

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overprescribing trend, but such outcomes have not been observed.[14-16]

Numerous efforts have attempted to stymie the over-prescription of opioids. The Centers for Disease Control (CDC) recommends limiting first-time opioid prescriptions to 3 days or less.[17] Several workgroups implemented state-specific opioid prescribing guidelines such as the Michigan Opioid Prescribing Engagement Network (OPEN)[18-21] The Michigan OPEN guidelines, introduced in October 2017, provide procedure-specific recommendations for postoperative opioid prescriptions to opioid naive patients. These recommendations were informed by published studies, expert opinion, and patient-reported data from the Michigan Surgical Quality Collaborative, which maintains a clinical registry of general, vascular, and gynecological surgical procedures, capturing a random sample of 50 000 patients yearly.[22]

The effect of the Michigan OPEN guidelines on opioid prescription practice at the institution level has not been reported. We sought to evaluate the change in opioid prescribing at our academic center and identify factors associated with nonadherence to the OPEN guidelines.

Methods

Study Population

Following institutional review board approval (IRB #12915), this single-center retrospective study reviewed opioid prescription data for adult patients (≥18 years) undergoing three ambulatory surgical procedures performed from January 2015 through September 2017 (pre-guidelines group) and November 2017 through December 2018 (post-guidelines group). Procedures in October 2017 were excluded to allow adequate time for guideline dispersion and initiation. Surgical procedures were identified using current procedural terminology (CPT) codes for laparoscopic/open appendectomy (CPT 44950, 44960, and 44970), laparoscopic/open cholecystectomy (CPT 47562, 47563, 47564, 47600, 47605, 47610, 47612, and 47620), and laparoscopic/open inguinal or femoral hernia repair (CPT 49505, 49507, 49520, 49521, 49525, 49550, 49553, 49555, 49557, 49650, and 49651). The institution studied is an 877-bed tertiary care center in a major metropolitan area and is accredited by the Accreditation Council for Graduate Medical Education. Ambulatory surgical procedures were chosen to avoid confounders of prolonged hospital stay and postoperative morbidity. Cases with a length of stay (LOS) over 1 day were excluded to limit the study population to patients with an expected postoperative course for the procedures evaluated. Variables with missing information were excluded. This study complies with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement for retrospective studies.[23]

Guideline Implementation and Dispersion

Multiple institutional memorandums accompanied the implementation of these guidelines via e-mails to all surgical providers and additional checkpoints in the electronic medical record prescribing process. Within the Electronic health record (EHR), a provider can prescribe a 3-day supply of opioids after a surgical procedure without requiring review of the Michigan Automated Prescription System (MAPS) for that patient. If a provider wishes to prescribe a larger supply than 3 days (and outside of prescribing guideline recommendations), a hard stop appears which requires the provider to provide his/her electronic signature to ensure that the MAPS has been reviewed and justification for the need of a prolonged supply has to be provided to proceed with the prescription. Additionally, at the end of the prescription process, there is a hard stop for the provider which prompts whether opioid counseling has been provided to the patient.

Total Morphine Equivalent Calculation

Opioid prescribing was recorded as total morphine equivalents (TMEs). For the included surgical procedures, 10 tablets of 5 mg oxycodone (TME = 75 mg), 15 tablets of hydrocodone 5 mg (TME = 75 mg), 15 tablets of codeine 30 mg (TME = 67.5 mg), or 15 tablets of tramadol 50 mg (TME = 75 mg) were sufficient according to the Michigan OPEN guidelines.[20] The TME was calculated from the total mg of the prescribed drug (number of tablets multiplied by dose per tablet). Conversion was as follows: 1 mg oxycodone = 1.5 mg TME, 1 mg hydrocodone = 1 mg TME, 1 mg codeine = .15 mg TME, and 1 mg tramadol = .1 mg TME.[24] For simplicity, a prescription over 75 mg TME was considered as guideline nonadherence.

Variables Analyzed

Patient characteristics extracted for analysis included age, sex, race, and American Society of Anesthesiologists (ASA) class. Procedure details recorded included surgical service (acute care surgery, general surgery, or other), surgical approach (laparoscopic or open), emergent status, operative time, and LOS. The general and acute care surgery services consist of sixteen and ten surgeons, respectively. The latter comprises a departmental unit, whereas the former represents a heterogenous surgeon group including general, bariatric, colorectal, hepatobiliary surgeons, and surgical oncologists. The general

surgery group performs the majority of surgeries in an outpatient and elective setting, whereas the acute care surgery service cases vary in terms of both procedural urgency and time of time. Age and operative time were reported as continuous variables. The ASA class was dichotomized to ≤ 2 and > 2 and LOS to 0 or 1 day. Prescription details included mean TME, opioid type (hydrocodone, oxycodone, tramadol, and codeine), and type of prescriber [resident, staff surgeon, or nonphysician provider (NPP)]. The latter consisted of physician assistants and nurse practitioners. In Michigan, since March 22, 2017, individuals licensed as physician assistants are eligible for controlled substance prescribing.[25] In contrast, mid-level practitioners, such as nurse practitioners, cannot independently prescribe without the identity of the delegating prescriber's identity appearing on the prescription. Though residents and NPPs were able to prescribe medications independently, the prescriptions require cosigning by the senior staff.

Statistical Analysis

Continuous variables were described using mean and standard deviation, and categorical variables were described using frequency and percentage. Student's *t*-test was used for continuous variables and chi-square test for categorical variables. The *F* test was used for variance comparisons. Multivariable logistic regression was used to identify independent risk factors (demographics, procedure factors, and prescription factors) for any opioid prescription nonadherence. Variables with a *P*-value < .10 in the univariate analysis were included in the model, and adjusted odds ratios (AORs) were reported with 95% confidence intervals (CIs). Statistical significance was set to $P < .05$. All statistical analyses were performed using SPSS version 25 (IBM Corporation, Armond, New York, USA).

Results

A total of 1493 cases were identified, 903 of which were pre-guidelines and 590 were post-guidelines. Patients in both groups were similar in age, sex, race, ASA class, surgical service performing the procedure, rates of emergency procedures, operative time, LOS, and type of opioid prescribed. There were no missing data on opioid prescription. The post-guidelines group had a higher proportion of inguinal/femoral hernias performed and open surgical procedures. The majority of procedures in both groups were performed laparoscopically.

The most common opioid medication prescribed in both groups was hydrocodone, followed by oxycodone. Residents were the main opioid prescribers in both groups, although a higher proportion of NPPs prescribed post-guidelines. The mean TME prescribed significantly decreased after the release of the guidelines (231.9 ± 108.6 mg pre-guidelines vs. 112.7 ± 73.9 mg post-guidelines; $P < .01$) (Table 1). There was a higher variance in the opioid amount prescribed pre-vs. post-guidelines ($F = 2.16$, df = 902; $P < .01$). The trend in TME prescribed is shown in Figure 1. More providers prescribed opioids within recommended limits post-guidelines (Table 1). The trend in adherence to opioid prescribing guidelines is shown in Figure 2. Among the non-adherence cases, a higher proportion of patients were men (53.7% vs. 44.3%; $P = .02$), black (43.9% vs. 37.9%; $P = .03$) and had a higher ASA class (ASA > 2 36.5% vs. 24.2%; $P < .01$). A higher percentage of these cases were prescribed opioids by NPPs (37.4% vs. 28.4%; $P = .04$) (Table 2).

On multivariable analysis, independent risk factors for guideline nonadherence included procedures with ASA class > 2 (AOR 1.65, 95% CI 1.09-2.49; $P = .02$), procedures performed by a general surgery service compared to an acute care surgery service (AOR 1.89, 95% CI 1.15-3.10; $P = .01$), the choice of oxycodone compared to hydrocodone (AOR 1.90, 95% CI 1.06-3.41; $P = .03$), and NPP prescriber compared to a resident (AOR 2.10, 95% CI 1.142-3.11; $P < .01$) (Table 3).

Discussion

Following the implementation of the Michigan OPEN guidelines, opioid prescribing after several common surgical procedures at our institution significantly decreased. Moreover, this study has identified several predictors of guideline nonadherence, including the type of opioid prescribed as well as certain patient and provider characteristics.

Support of standardized opioid prescribing stems from observed significant variations in inter-provider prescribing habits.[26-29] We found reduced variability in the opioid amount prescribed in the post-guidelines group, confirming this benefit of standardized opioid prescribing. Freedman-Weiss et al[30] found no difference between NPP and resident prescribing, whereas in our study, NPPs were more likely than residents to overprescribe opioids. Eid et al noted variation in opioid prescribing patterns among similar surgery on the same acute care surgery service, noting more pronounced variation when surgical trainees were the prescribing providers rather than NPPs. Similar to our study, residents were most often the prescribing providers. There was a larger proportion of NPP prescribing in the later era of the study period. Though there were no direct institutional changes made to account for this, there has been an increased degree of departmental NPP support, which may have displaced certain clinical activities, such as prescribing, to NPPs to support resident education and allow for increased operative experience for the residents.

Table 1. Variables Stratified by Guideline Introduction (October 2017).[a]

Variable		Before October 2017 (N = 903)	After October 2017 (N = 590)	P-value
Age, years		43.8 ± 18.0	45.5 ± 17.8	.08
Sex	Female	477 (52.8%)	298 (50.5%)	.38
	Male	426 (47.2%)	292 (49.5%)	
Race	White	328 (36.3%)	203 (34.4%)	.74
	Black	358 (39.7%)	243 (41.2%)	
	Other	217 (24.0%)	144 (24.4%)	
Hispanic	Not Hispanic	758 (84.0%)	500 (84.8%)	.91
	Hispanic	93 (10.3%)	57 (9.7%)	
	Unknown	52 (5.8%)	33 (5.6%)	
ASA class	≤2	603 (66.8%)	407 (69.0%)	.37
	>2	300 (33.2%)	183 (31.0%)	
Service	Acute care surgery	704 (78.0%)	465 (78.8%)	.88
	General surgery	186 (21.0%)	118 (20.0%)	
	Other	13 (1.4%)	7 (1.2%)	
Procedure	Appendectomy	353 (39.1%)	185 (31.4%)	<.01
	Cholecystectomy	393 (43.5%)	238 (40.3%)	
	Inguinal/femoral herniorrhaphy	157 (17.4%)	167 (28.3%)	
Approach	Laparoscopic	777 (86.1%)	455 (77.1%)	<.01
	Open	126 (14.0%)	135 (22.9%)	
Emergent	No	566 (62.7%)	357 (60.5%)	.40
	Yes	337 (37.3%)	233 (39.5%)	
Operative time, minutes		120.8 ± 38.1	122.0 ± 34.4	.54
LOS, days	0	451 (50.0%)	298 (50.5%)	.83
	1	452 (50.1%)	292 (49.5%)	
TME, mg		231.9 ± 108.6	112.7 ± 73.9	<.01
Opioid	Hydrocodone	815 (90.3%)	516 (87.5%)	.05
	Oxycodone	74 (8.2%)	65 (11.0%)	
	Tramadol	2 (.2%)	5 (.9%)	
	Codeine	12 (1.3%)	4 (.7%)	
Prescriber	Resident	647 (71.7%)	392 (66.4%)	.01
	Staff	8 (.9%)	1 (.2%)	
	Nonphysician provider	248 (27.5%)	197 (33.4%)	
TME ≤ 75 mg	Yes	25 (2.8%)	264 (44.8%)	<.01
	No	878 (97.2%)	326 (55.3%)	

Abbreviations: ASA, American Society of Anesthesiologists; LOS, length of stay; TMEs, total morphine equivalents.
[a]Continuous variables are represented as mean ± standard deviation and categorical variables are represented as frequency (percentage).

Despite the promising drop in opioid prescribing after the adoption of the Michigan OPEN guidelines, overall compliance with the guidelines in our study was relatively low, with less than 50% provider adherence. This may be explained by inadequate education of prescribing recommendations and also by the potential to break established prescribing habits. Though memorandums via email were used to disseminate guidelines, likely additional educational activities (such as in-person sessions, town halls) would be required to increase adherence further. Within this context, there are limited data on how to implement prescribing guidelines most effectively.[31] This may involve incorporating expectations of postoperative opioid prescribing into patient counseling sessions during clinic visits and weekly prescriber feedback on prescribing adherence. Ultimately, the degree to which the poor adherence can be attributed to a guideline unawareness remains unclear, and further studies using questionnaires to providers may offer additional insight into how further refinements to guidelines and improved adherence can be achieved.

Various other factors have been identified as predictors of nonadherence. In an evaluation of 1606 patients who underwent laparoscopic cholecystectomy, Hanson et al reported that over half of opioid naive patients in their cohort were prescribed opioids that exceeded their state's draft guidelines and were more likely to receive a discharge opioid prescription compared to preoperative opioid users. They speculated that prescribing habits were guided by the notion that preoperative opioid users may have had a sufficient supply to manage their postoperative pain. Moreover, younger age (18-49 years), gallstone pancreatitis, higher pain scores, longer LOS, and emergent status were identified to be associated with top
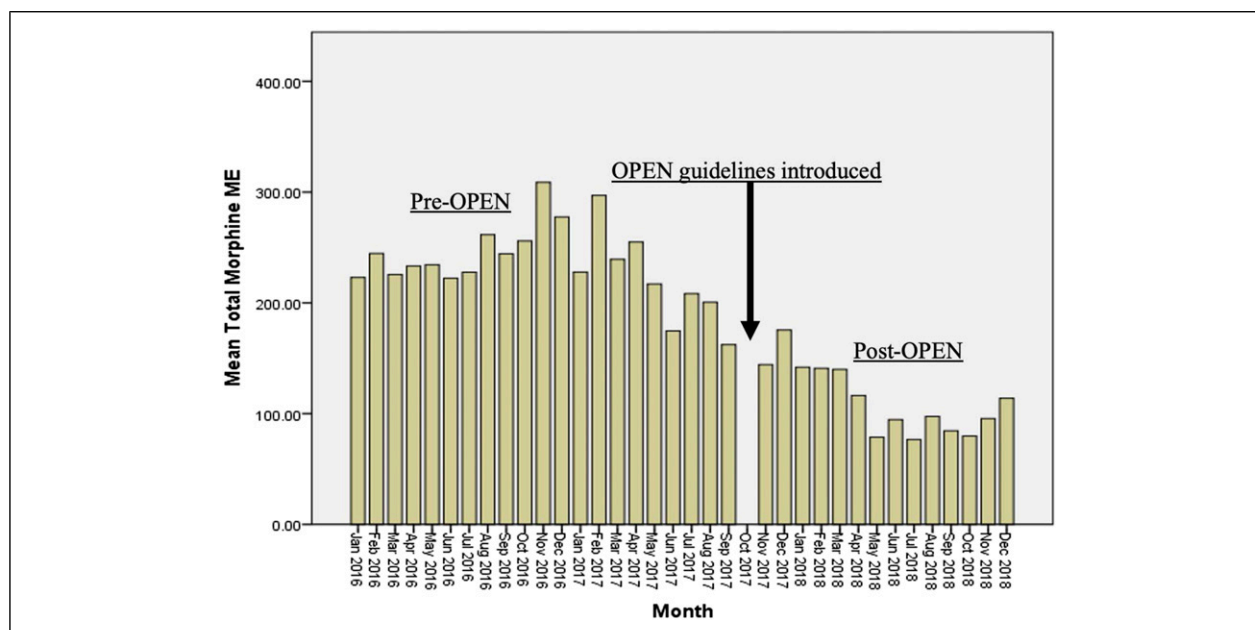
Figure 1. Total morphine equivalents prescribed over time (Opioid Prescribing Engagement Network guidelines introduced in October 2017).
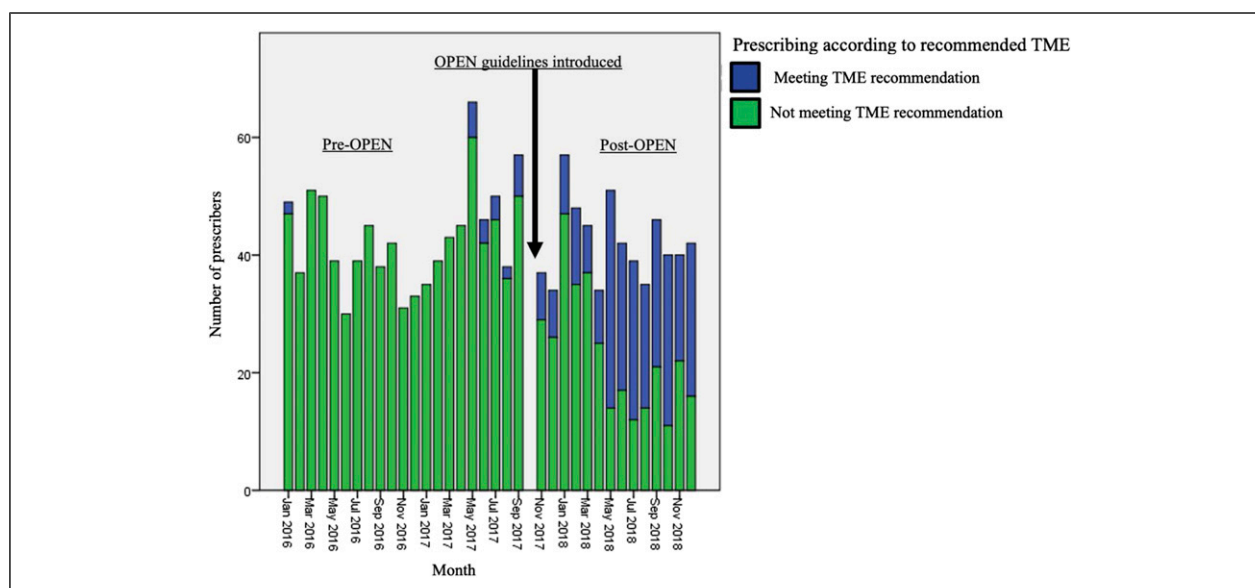

Figure 2. Trend in opioid prescribing and whether providers adhered to (post-October 2017) or would have adhered to (pre-October 2017) opioid prescribing guidelines.

quartile opioid prescriptions.[32] After adjustment, only younger age and gallstone pancreatitis remained as independent risk factors. In our study population, likely as a result of different study designs, the only independent patient-specific risk factor for opioid guideline nonadherence identified was ASA > 2. The reason why these independent risk factors elevated the risk of nonadherence is unclear. An ASA > 2, a surrogate for patients with

severe systemic disease, may have led to prescriber bias to expect that these patients may experience a more protracted postoperative course and therefore require a higher number of opioid mediations.

Provider-specific risk factors for opioid guideline nonadherence included choice of oxycodone, general surgery service, and NPP prescriber. The selection of oxycodone, a more potent opioid than hydrocodone, as

Table 2. Variables Stratified by Provider Adherence to Opioid Guidelines After October 2017.[a]

Variable		Guideline adherence[b] (N = 264)	Guideline nonadherence[b] (N = 326)	P-value
Age, years		43.9 ± 17.9	46.8 ± 17.7	.05
Sex	Female	147 (55.7%)	151 (46.3%)	.02
	Male	117 (44.3%)	175 (53.7%)	
Race	White	86 (32.6%)	117 (35.9%)	.03
	Black	100 (37.9%)	143 (43.9%)	
	Other	78 (29.6%)	66 (20.3%)	
Hispanic	Not hispanic	225 (85.2%)	275 (84.4%)	.91
	Hispanic	24 (9.1%)	33 (10.1%)	
	Unknown	15 (5.7%)	18 (5.5%)	
ASA class	≤2	200 (75.8%)	207 (63.5%)	<.01
	>2	64 (24.2%)	119 (36.5%)	
Service	Acute care surgery	222 (84.1%)	243 (74.5%)	.02
	General surgery	40 (15.2%)	78 (23.9%)	
	Other	2 (.8%)	5 (1%)	
Procedure	Appendectomy	87 (33.0%)	98 (30.10%)	.06
	Cholecystectomy	115 (43.6%)	123 (37.70%)	
	Inguinal/femoral herniorrhaphy	62 (23.5%)	105 (32.20%)	
Approach	Laparoscopic	214 (81.1%)	241 (73.9%)	.04
	Open	50 (19.0%)	85 (26.1%)	
Emergent	No	160 (60.6%)	197 (60.4%)	.97
	Yes	104 (39.4%)	129 (39.6%)	
Operative time, minutes		122.2 ± 34.6	121.8 ± 34.3	.91
LOS, days	0	143 (54.2%)	155 (47.6%)	.11
	1	121 (45.8%)	171 (52.5%)	
Opioid	Hydrocodone	242 (91.7%)	274 (84.1%)	.05
	Oxycodone	19 (7.2%)	46 (14.1%)	
	Tramadol	2 (.8%)	3 (.9%)	
	Codeine	1 (.4%)	3 (.9%)	
Prescriber	Resident	189 (71.6%)	203 (62.3%)	.04
	Staff	0 (.0%)	1 (.3%)	
	Nonphysician provider	75 (28.4%)	122 (37.4%)	
TME, mg		62.1 ± 13.7	153.7 ± 77.4	<.01

Abbreviations: ASA, American Society of Anesthesiologists; LOS, length of stay; TMEs, total morphine equivalents.
[a]Continuous variables are represented as mean ± standard deviation and categorical variables are represented as frequency (percentage).
[b]Guideline adherence is defined as TME ≤ 75 mg vs. guideline nonadherence is defined as TME > 75 mg.

the prescribed opioid can be driven by provider preference or patient factors such as allergies to alternative agents. Anecdotally, a "weaker" opioid, such as hydrocodone, would more often be prescribed to opioid naive patients. Consequently, patients who received an oxycodone prescription may have been non-opioid naive and thus may have led the provider to overprescribe with the expectation that the patient may require a higher dose of opioids. The general and acute care surgery services differ both in the number of surgeons comprising each group, but also procedural urgency, and departmental unity in terms of specific morbidity and mortality and education conferences. Moreover, the acute care surgery service performs the majority of the selected procedures included in this study and given the more unified departmental structure, which may have contributed to more rapid guideline dissemination and implementation. It is not clear why NPP prescriber was an independent risk factor

for guideline nonadherence. Still, it may be related to discrepancies in education about opioid guidelines and differences in established prescribing patterns. Compared to NPPs, residents may be more likely to parse scientific literature, which has seen an increase in articles highlighting the opioid epidemic in recent years. Within this context, and lastly, trainees may be more rapid to adopt new practice guidelines than non-trainees based on the virtue of their role. Moreover, despite adjustments for patient and operative variables, it is conceivable that the differences observed in NPP prescribing may be related to residual confounding and the patient population to which they prescribed.

Despite the identification of the factors mentioned previously, education remains the most promising area for quality improvement.[14,33] Using patient surveys to define postoperative opioid requirements, Hill et al[34] developed operation-specific guidelines, which led to more than

Table 3. Multivariable Analysis of Predictors for Opioid Prescribing Nonadherence.

Variable		AOR[a] (95% CI)	P-value
Age, per 10 years increase		.99 (.88-1.11)	.81
Sex	Female	1.00	Reference
	Male	1.18 (.78-1.79)	.43
Race	White	1.00	Reference
	Black	1.07 (.72-1.59)	.75
	Other	.67 (.43-1.07)	.09
ASA class	≤2	1.00	Reference
	>2	**1.65 (1.09-2.49)**	**.02**
Service	Acute care surgery	1.00	Reference
	General surgery	**1.89 (1.15-3.10)**	**.01**
	Other	2.38 (.39-17.70)	.35
Procedure	Appendectomy	1.00	Reference
	Cholecystectomy	.87 (.56-1.34)	.51
	Inguinal/femoral herniorrhaphy	1.18 (.51-2.74)	.70
Approach	Laparoscopic	1.00	Reference
	Open	.95 (.45-2.13)	.95
Opioid	Hydrocodone	1.00	Reference
	Oxycodone	**1.90 (1.06-3.41)**	**.03**
	Tramadol	1.14 (.16-8.19)	.90
	Codeine	2.68 (.25-28.25)	.41
Prescriber	Resident	1.00	Reference
	Staff	—[b]	—[b]
	Nonphysician provider	**2.10 (1.42-3.11)**	**<.01**

Abbreviations: AOR, Adjusted odds ratio; CI, Confidence interval; ASA, American Society of Anesthesiologists. Significant variables are in **bold** defines as $P < .05$.
[a]Variables adjusted for those with $P < .10$ in the univariate analysis.
[b]The number of events was zero in one of the groups and statistical analysis could not be performed.

a 50% reduction in the number of opioids prescribed without increasing the number of opioid refill prescriptions. In another study, Hill et al[35] found that postdischarge opioid use could be best predicted by usage the day before discharge, which, if taken into account for discharge prescription, could reduce opioid prescription by 40%. Notwithstanding this, though opioid prescribing can be decreased, what constitutes an optimal postoperative pain regimen remains to be fully elucidated. Though this is likely to vary from patient to patient, it has to be recognized that the aim of opioid reducing strategies should not only be to decrease opioid prescription and patient use but also identify non-opioid analgesic medications as alternatives. Hence, a holistic and individualized approach to postoperative analgesia is likely to be more beneficial, particularly in the setting of heightened physician and hospital awareness of hospital ratings that result from patient satisfaction scores.[15,16] These changes should also emphasize patient involvement and education to improve understanding of what constitutes ideal pain regimen in various patient and procedural scenarios. From a prescribing provider standpoint, efforts should be focused on accountability rather than on punitive measures. Additional strategies to further improve guideline compliance include weekly reminders on prescribe performance on guideline adherence which can provide real-time opportunities for feedback and improvement. As an extension of this, designated staff surgeon opioid prescribing champions can contact outlier prescribers on a regular basis on to clarify reasons for noncompliant prescribing. For intraoperative pain management, patients may benefit from receipt of multimodal pain management with 2 agents (such as acetaminophen, muscle relaxants, nonsteroidal anti-inflammatory drugs, ketamine, and dexmedetomidine). The use of regional anesthesia may further decrease patient reliance on opioid medications prescribing. Last, on discharge, providers should provide and document that opioid education has been provided regarding opioid use and addiction. While formal CDC-based and statewide guidelines such as the Michigan OPEN have been implemented successfully with promising early results across multiple institutions,[22] our single-center study offers insight into potential independent predictors of nonadherence to guidelines, highlighting opportunities for further improvement both in terms of patient and provider education and through targeting specific risk factors associated with provider guideline nonadherence.

This study has several limitations. It is a retrospective study of single institutional data, with inherent limitations

due to non-randomization, the potential for selection, and misclassification bias. Additionally, the lack of randomization makes evaluating the effect of the intervention (guideline implementation) challenging, as it is possible that opioid prescribing may have already been decreasing before the intervention. The study's single institutional nature limits the generalizability of the results. The data were limited to the ambulatory type of procedures and may, therefore, not apply to patients requiring hospital admission after the procedure. The study population selected was limited to patients with an expected postoperative course (LOS < 1 day), which does not capture patients who experience inadequate postoperative pain control, which may potentially have resulted in a decreased guideline adherence. Quality of life questionnaires, information on opioid refills, and pain score evaluations were not recorded. Many variables are lacking, such as patients' preoperative opioid use. Our results may have been skewed as we did not account for socioeconomic status and comorbidities. However, these factors are not associated with opioid prescribing.[36] Nonetheless, these data provide real-world information on opioid prescribing patterns of providers before and after implementation of statewide opioid prescribing guidelines.

Conclusion

While opioid prescribing guidelines overall positively impacted providers' opioid prescribing habits after common general surgical procedures in an ambulatory setting, there is an opportunity for further improvement. Several factors associated with provider nonadherence to recommended guidelines may identify actionable targets to minimize opioid overprescribing further.

Author's Note

This project was submitted for presentation to the 15th Annual Academic Surgical Congress February 4-6, 2020, Orlando, FL, USA.

Author Contributions

Tommy Ivanics contributed to data interpretation and writing the original manuscript. Hassan Nasser performed analytic calculation and contributed to writing and revision of the manuscript. Pridvi Kandagatla contributed to data interpretation and revision of the manuscript. Shravan-Leonard Murali verified the analytical methods and contributed to writing the original draft of the manuscript. Adam Jones contributed through abstraction of data variables used for the analysis. Marwan Abouljoud contributed to data interpretation and revision of the manuscript. Arielle Hodari Gupta contributed to revision of the manuscript. Ann Woodward supervised the project as well as contributed to revision of the manuscript.

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