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Original Research

Variation in Postoperative Opioid Prescribing Among Upper-Extremity Surgery Providers

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Purpose: To identify targets for corrective interventions and guide improved opioid stewardship, we studied opioid prescribing patterns of attending surgeons compared with surgical trainees for 2 upper-extremity surgeries: open reduction internal fixation (ORIF) of distal radius fractures (DRF), and carpal tunnel release (CTR).

Methods: We retrospectively reviewed records for all patients who underwent CTR or DRF ORIF at 6 hospitals across a large health system from 2016 to 2018. We collected prescriber training level (attending vs trainee), analgesic prescribed, and amount initially prescribed after surgery converted to oral morphine equivalents (OMEs). Regression models evaluated OMEs by prescriber and surgery type. Our final models included an interaction term between prescriber training level and year of surgery to assess group changes over time. No prescription guidelines or formal training was provided during the study period.

Results: We included 707 CTR and 383 DRF ORIF patients. Opioids prescribed by trainees ranged from 90 to 300 OMEs (median, 180 OMEs). Opioids prescribed by attendings ranged from 100 to 225 OMEs (median, 150 OMEs). Early in the analyses, trainees prescribed significantly more than attendings (320 versus 180). Over time, trainees reduced overprescribing significantly more, by an additional 40 OME/y. By the end of the analysis period, trainees were prescribing less OME than were attendings (112.5 vs 150). Both groups continued to prescribe more than recently suggested amounts for both procedures.

Conclusions: Our study found that both attendings and trainees overprescribed opioids after surgery. Trainees prescribed more than attendings over the study period; however, when analyzing for improvement over time and with no formal intervention or training, trainees showed greater improvement, eventually dropping to levels at or below that of attendings. Considering that most change was seen at the trainee level, education for established providers may be an area in which more improvement can be made.

Clinical relevance: Understanding which providers are more likely to overprescribe opioids can help guide interventions that improve opioid stewardship.

Over the past several years there has been increasing concern regarding the quantity of opioids prescribed after outpatient surgery. Numerous studies suggested a risk for long-term opioid use after even low-risk surgery, regardless of specialty.[1,2] Over one-fifth of opioid-naive patients continue to use opioids 90 days after hand surgery procedures.[3] Unused prescriptions contribute to misuse by other members of the household or community[4,5] and opioid diversion is also a risk; studies showed that only 34% of

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prescriptions are used by patients.[6] Yet even with the ongoing opioid crisis, physicians have continued to overprescribe, in part owing to patient influence, health care constraints, and convenience.[7] Approaches to improve opioid stewardship and minimize risks associated with opioid overprescribing after upper-extremity surgery must be appropriately targeted as we aim to address the crisis.

Multiple studies have investigated provider prescription habits for outpatient surgery; however, most assessed what providers think they would prescribe rather than actual prescription behavior.[8] A self-reported survery of surgeons found that experience level is a factor in prescription habits.[9] Although some surgeons rely on trainees to provide prescriptions at discharge, few have established prescription guidelines to promote consistency.[10] Another major concern with postoperative prescription amounts is the perceived incentives to overprescribe or pad the prescription and give more than needed. A study of general surgery residents suggested that there may be a large disparity between what surgeons in training prescribe and what they think the average patient will actually use, which suggests that they may overprescribe to prevent the inconvenience of patients returning for refills.[11] In addition, concerns about lower patient satisfaction if pain needs are not met may encourage padding prescriptions by any provider.[12] However, studies reported that patient satisfaction with pain control is best predicted by self-efficacy and not amounts of opioids prescribed,[13] whereas higher prescribed perioperative opioids have been linked to greater postoperative opioid use, not less.[14,15] Another study identified a lack of opioid prescription training for residents,[16] and a quality improvement survey study found that for attending surgeons, aside from federally mandated Opioid Prescriber Safety Training, less than 50% of respondents received formal opioid prescription training from the state or surgical department.[17] More recently, there has been increased attention to formalizing guidelines for upper-extremity postoperative opioid prescribing.[10,18,19] Yet, the lack of prescriber education protocols and inadequate understanding of physician prescription practices limit appropriate development and targeting of interventions designed to improve opioid stewardship.

The purpose of this study was to assess the potential need and target groups for opioid prescribing education by evaluating prescribing patterns of surgical trainees and attending surgeons after 2 common outpatient upper-extremity procedures, open reduction internal fixation (ORIF) of distal radius fractures (DRF) and carpal tunnel release (CTR), across 3 years in a geographically and clinically diverse major metropolitan health system. We used published suggested prescribing of 50 oral morphine equivalents (OMEs) for CTR and 112.5 OMEs for ORIF DRF,[10] equivalent to approximately 7 5-mg and 15 5-mg oxycodone pills, as a guide to understand how providers in our system were aligning with proposed amounts. We hypothesized that trainees would prescribe on average a greater quantity with greater variation compared with attendings. In addition, we hypothesized that because none of the hospitals in our system provided formal prescription reduction intervention during the years studied, prescribing habits would remain consistent over time for both attendings and trainees.

Materials and Methods

Study population

After obtaining institutional review board approval, we conducted a retrospective review across 6 different hospitals within a single health system. This included 2 community hospitals without training programs, 3 non-university hospitals with training programs, and one university academic hospital. Patients were identified using Current Procedural Terminology codes for DRF repairs and CTR performed between 2016 and 2018, and all operative notes were reviewed for confirmation. We excluded patients who were younger than age 18 years, underwent multiple procedures on the same day, had listed allergies to any opioid medication or nonsteroidal anti-inflammatory medication, were given an opioid prescription within 7 days before surgery (based on patient report from medication screening in the preanesthesia care unit on the day of surgery), or had a preexisting pain management or narcotics contract. The final cohort included 1,085 patients.

Explanatory and outcome variables

The primary outcome variable was the amount of opioid medication prescribed after surgery, given to the patient on the day of surgery. The type of narcotic and number of pills were recorded; prescriptions were converted to OMEs (Appendix A, available on the *Journal's* Web site at www.jhsgo.org) for standardization.[20,21]

Explanatory variables included prescriber type, specialty, and type of surgery. Residents and fellows were both classified as trainees; attendings were a separate group. We recorded the date of the procedure to track prescription patterns over time. We also recorded patients' tobacco use, history or current diagnoses of substance abuse, pain disorder, mental health conditions, diabetes, hypertension, malignancy, and previous opioid use. Other covariates of interest included patient age, sex, race, and body mass index (BMI). We did not include location as an explanatory variable because of the unequal distribution of surgical cases across the hospitals, in which 2 sites had few cases (Appendix B, available on the *Journal's* Web site at www.jhsgo.org, shows the distribution of OME prescription records across hospitals).

Statistical analysis

Medians with interquartile ranges and frequencies are used to present continuous and categorical variables, respectively, and to investigate the distribution of surgeries over the study period (Table 1). We compared differences in median OME prescription between prescriber groups, year of procedure, and type of procedure using the quantile regression test (Table 2).

We used bivariate linear regression models to investigate the association between mean OME prescription and independent variables. We then conducted multivariable linear regression analysis, adjusting for prescriber type, specialty, year of surgery, procedure type, patient age, sex, race, BMI, history of depression, pain disorder diagnosis, and prior consumption of opioids. In addition, an interaction term between prescriber type and year of surgery was added to evaluate whether the association of OME prescribed and prescriber type was modified by the year in which the surgery was performed. The level of significance was set at .05.

Results

Median age of patients was 57 years (interquartile range [IQR], 46–66 years) with a median BMI of 29.5 (IQR, 25–35). Women constituted 71% of the study population (n = 767) and most patients were white (n = 709; 65%). The total cohort median OME prescribed was 150 (IQR, 90–262). Trainees accounted for 76% of all prescriptions. Other group data are summarized in Table 1.

There was a statistically significant difference in the median OMES prescribed among prescriber groups, procedure type, and year of procedure (Table 2, Figs. 1–3). Overall, trainees prescribed significantly higher median OMES compared with attendings (180 vs 150; IQR, 90–300 vs 100–225; $P = .028$). The median OMES prescribed decreased by year ($P < .001$), from 300 in 2016 (IQR,

Table 1
Descriptive Statistics (N = 1,085)

Cohort Demographics	n (%)	Median (IQR)
Prescriber		
Trainee	833 (76.8)	
Attending	252 (23.2)	
Procedures by prescriber type		
Carpal tunnel release	702 (64.7)	
Trainee	505 (71.9)	
Attending	197 (28.0)	
Distal radius fracture repair	383 (35.3)	
Trainee	328 (85.6)	
Attending	55 (14.4)	
Prescriber specialty		
Orthopedic surgery	691 (63.7)	
Plastic surgery	353 (32.5)	
Other	41 (3.8)	
Year of surgery		
2016	225 (20.7)	
2017	400 (36.9)	
2018	460 (42.4)	
Patient age		57 (46–66)
Patient sex		
Male	318 (29.3)	
Female	767 (70.7)	
Patient race		
White	709 (65.3)	
Black	302 (27.8)	
Asian	13 (1.2)	
Native American/Pacific Islander	2 (0.2)	
Other	59 (5.5)	
Patient BMI		29.46 (25–35)
Patients' medical history:		
Diabetes	184 (17)	
Hypertension	529 (48.8)	
Anxiety	201 (18.5)	
Depression	224 (20.7)	
Malignancy	81 (7.5)	
Pain disorder	45 (4.2)	
History or current:		
Tobacco use	207 (19)	
Alcohol abuse	47 (4.3)	
Substance abuse	76 (7)	
Received chronic preoperative opioid prescription	122 (11.2)	
Received chronic preoperative neuromodulator prescription	112 (10.3)	

Table 2
Distribution of Prescribed OMEs

Categorical Group	Median (IQR)	*P* Value
Prescriber type		.028*
Trainees	180 (90–300)	
Attendings	150 (100–225)	
Year of surgery		<.001*
2016	300 (150–450)	
Trainees	320 (225–450)	.002*
Attendings	180 (150–300)	
2017	180 (90–250)	
Trainees	180 (90–300)	<.001*
Attendings	120 (98–225)	
2018	116 (75–210)	
Trainees	112.5 (60–210)	.01*
Attendings	150 (90–225)	
Procedure type		<.001*
Carpal tunnel release	120 (75–210)	
Distal radius fracture repair	225 (180–375)	

* Significance defined as $P < .05$.

150–450) to 180 in 2017 (IQR, 90–250) and 116 in 2018 (IQR, 75–210). As expected, CTR patients received significantly lower median OMES (120, IQR, 7 –210) compared with DRF patients (225; IQR, 180–375; $P < .001$).

Based on a series of bivariate linear regression analyses using a *P* value cutoff of 0.1 (Table 3, unadjusted results), we developed a final multivariable model with an interaction term added between prescriber type and year of surgery (Table 3, adjusted results). Of note, we included history of pain disorder in the multivariable model even though the bivariate analysis was above our cutoff, because we thought that it was important to adjust for this clinical component of pain management. Older patients, opioid-naive patients, and patients with no history of pain disorder were prescribed fewer OMEs. Notably, adjusting for other covariates, the interaction term between prescriber type and year of surgery was significantly associated with a decrease in OME prescription by 40 units (95% confidence interval, −64.15 to −15.70; $P = .001$) (adjusted results in Table 3, Fig. 4). This indicates that with every 1-year increase, whereas an attending prescribed 43 fewer OMEs than the previous year (95% confidence interval, −64.35 to −21.7; $P < .001$), a trainee prescribed 83 fewer OMEs than the previous year.

Discussion

Over the 3 years studied, our results are consistent with the hypothesis that trainees prescribe more OMEs compared with attending surgeons. This aligns with previous studies that reported surgical residents prescribed more morphine milligram equivalents than do attending surgeons.[22] However, when more closely evaluating trends year after year, we saw a marked improvement in trainee OME prescriptions, with far less change in attending prescribing. By 2018, trainees were prescribing less than attendings. The continued overprescribing of opioids after surgery by attendings and the lack of improvement over time brings attention to the need for improvement in prescription practices of attending surgeons.

The changes in prescribing seen in our study occurred with no organized training or education provided to the trainees. This may point to increasing awareness of the opioid epidemic with associated improvements in opioid stewardship within training programs, even with no formal intervention. Multiple studies have shown that when experimental postoperative guidelines are implemented, opioid prescriptions decrease.[10,23] However, for upper-extremity surgery, there remains no standardized post-surgical prescribing guidelines,[10] which may help explain the variability in opioid prescription habits in this study and why attending surgeon practices changed far less. Having institutional or standardized guidelines for postoperative opioid prescriptions in upper-extremity surgery may help reduce variability. Numerous studies showed that implementing prescribing guidelines in combination with patient education efforts reduces overprescribing and improves patient satisfaction.[14,18,23,24] After experimental prescription guidelines of 50 OMEs for CTR and 112.5 OMEs for DRF repairs[10] were introduced to hand surgeons, the amount of OMEs prescribed decreased.[10] The values from that study are substantially lower than OMEs prescribed in our study, which ranged from 100 to 300 for the respective procedures. This indicates that even with the improvements over time, we identified potential overprescribing by both attendings and trainees in our system.

Opioid prescription regulation is determined by the federal government, yet ultimately regulation falls on states for enforcement.[25] Since 2017, 43 states have enacted policies to regulate morphine equivalent daily dose thresholds.[26] These policies aim to limit the number of opioids prescribed by providers through guidelines, prior authorizations, and prescription drug monitoring programs. There is variation among states with policies and interventions, but over the past 3 years, morphine equivalent daily dose thresholds have decreased and policies are becoming more restrictive. Currently, 17 states have dosing

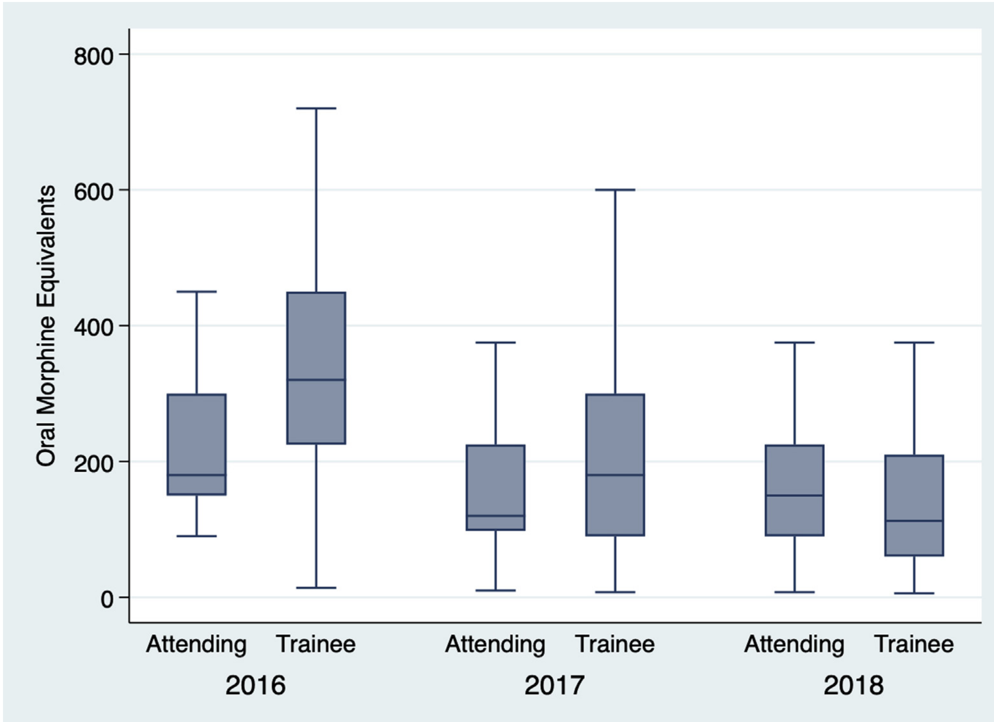

Figure 1. Overall prescription amounts by prescriber type and year of surgery.

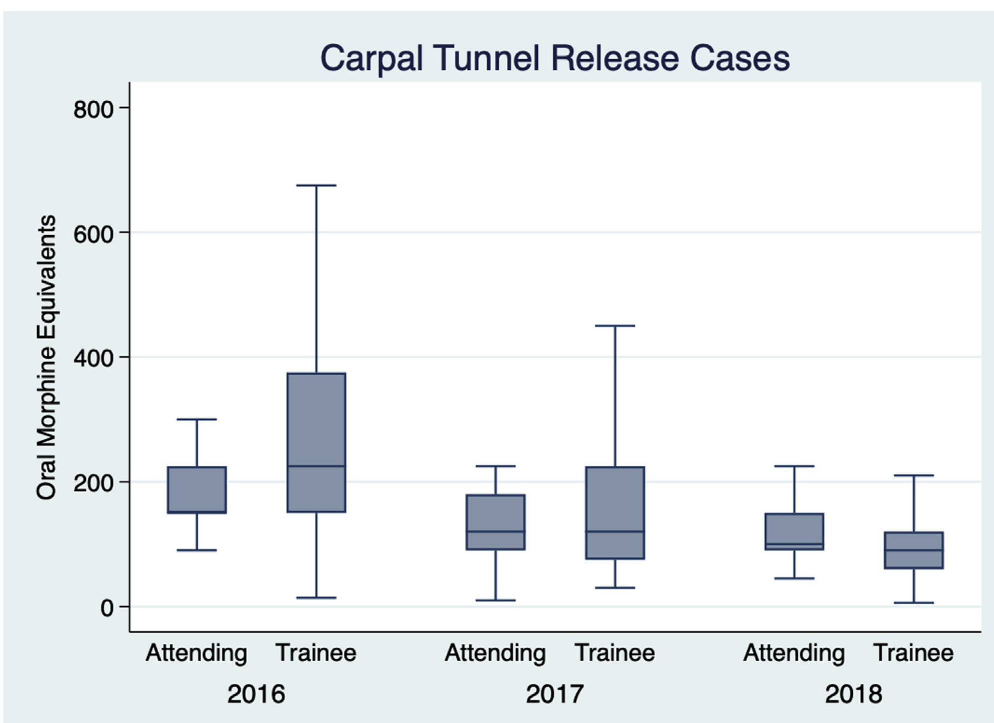

Figure 2. Prescription amounts for carpal tunnel release patients.

guidelines and 15 that require screening for opioid misuse.[26] However, guidelines implemented at the state level have shown variable effects on opioid prescribing. For example, in 2016, Massachusetts and Connecticut placed opioid prescription duration limit regulations for all opioid prescribers. This led to an immediate decrease in postoperative OMEs prescribed in Massachusetts; however, no change was seen in Connecticut.[27] Our study focused on a large hospital system based in Maryland and the District of Columbia, both of which did not have opioid guidelines during the years studied.

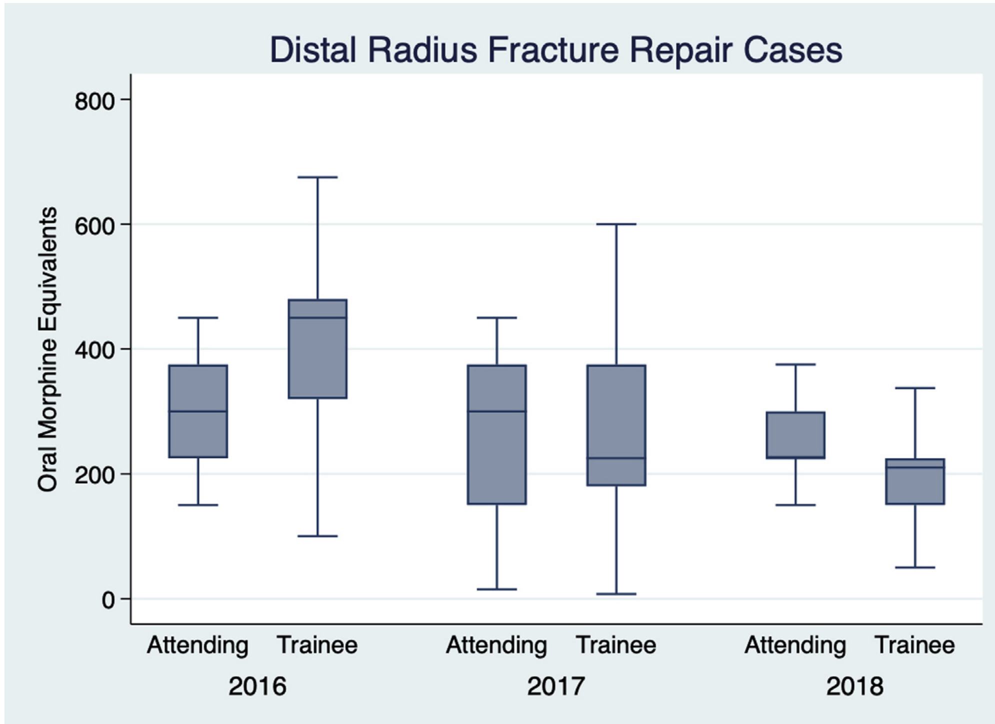

Figure 3. Prescription amounts for distal radius fracture repair patients.

Table 3
Unadjusted and Adjusted β Estimates for Models With OMEs Prescribed as Dependent Variable

Variable	Unadjusted Model		Adjusted Model	
	β Estimates (95% Confidence Interval)	*P* Value	β_1 Estimates (95% Confidence Interval)	*P* Value
Prescriber type				
Attending	Reference		Reference	
Trainee	19 (−3 to 41)	.090	57.54 (22.18 to 92.91)	.001*
Year	−74.80 (−86.02 to −63.57)	<.001*	−43.03 (−64.35 to −21.71)	<.001*
Interaction between prescriber type and year			−39.93 (−64.15 to −15.71)	.001*
Patient sex				
Male	Reference		Reference	
Female	9.66 (−10.64 to 29.96)	.351	3.54 (−13.98 to 21.06)	.692
Patient race				
White	Reference		Reference	
African American	−40.47 (−61.26 to −19.68)	<.001*	−9.32 (−28.42 to 9.77)	.338
Asian	−1.95 (−87.12 to 83.23)	.964	18.99 (−52.23 to 90.22)	.601
Native American or Pacific Islander	−108.10 (−323.61 to 107.41)	.325	−63.85 (−245.11 to 117.4)	.490
Other	−8.39 (−50.98 to 34.20)	.699	1.60 (−35.36 to 38.57)	.932
Patient age	−0.91 (−1.51 to −0.31)	.003*	−0.53 (−1.05 to −0.01)	.046*
Patient BMI	−0.91 (−1.53 to −0.27)	.005*	−0.04 (−0.65 to 0.58)	.898
Patient prior opioid use				
Opioid user	Reference		Reference	
Opioid-naive	−113.37 (−133.15 to −93.59)	<.001*	−49.13 (−68.22 to −30.03)	<.001*
Depression				
No diagnosis	Reference		Reference	
Diagnosis	−20.70 (−43.46 to 2.07)	.075	−19.34 (−39.36 to 0.68)	.058
Pain disorder				
No diagnosis	Reference		Reference	
Diagnosis	17.35 (−28.66 to 63.35)	.460	47.61 (7.87 to 87.34)	.019*
Procedure				
Carpal tunnel release	Reference		Reference	
Distal radius fracture repair	123.88 (106.08 to 141.68)	<.001*	105.82 (86.92 to 124.71)	<.001*
Provider specialty				
Orthopedic surgery	Reference		Reference	
Plastic surgery	−28.01 (−47.93 to −8.02)	.006*	−23.59 (−41.06 to −6.13)	.008*
Other	1.36 (−41.70 to 44.37)	.951	50.62 (9 to 92.23)	.017*

* Significance defined as $P < .05$.

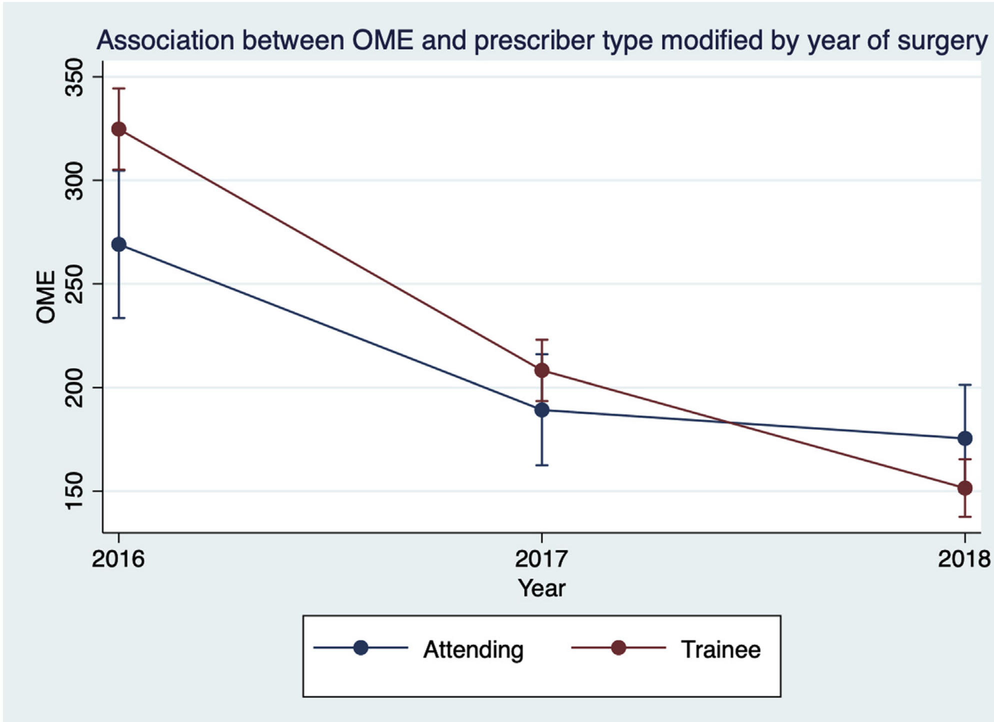

Figure 4. Interaction plot for OME prescribed, showing the association between OME and prescriber type modified by year of surgery.

Trainees in our study showed a significant decline in the amount of opioids prescribed by year with no formal training or intervention. Although there are concerns that trainees over-prescribe to avoid unhappy patients or postoperative phone calls,[11,23] this may be improving as awareness of the opioid crisis is broadening for providers as well as patients. It is reassuring that early results indicate that prescribing practices do not significantly affect patient-reported quality scores[28]; however, this has not been confirmed with patient-level analyses. In addition, it is unclear how many providers are aware of these early encouraging findings. A 2018 study found that the greatest influence on surgical residents' opioid prescription amounts was the preference of supervising physicians, including senior residents and attendings.[11] We cannot interpret from our results how much this affects our findings, but it is possible that educational culture and attending awareness of recent literature vary at the different institutions, and perhaps increased awareness by those affiliated with training programs facilitates better education and has an impact on trainee behavior.[29,30] Thus, attention to these elements and appropriate education and modeling for trainees may lead to continued improvement in trainee opioid prescribing. Whether efforts to reduce attending prescribing would then influence their trainees is interesting and may be the focus of future studies.

Attending surgeons' consistency in overprescribing from 2016 through 2018 brings into question what interventions are in place for established providers. In our study, attending surgeons did not notably change their prescribing behavior over the 3 years. Research suggested that like trainees, attendings will respond to guidelines aimed at reducing opioid prescriptions. One prospective study found that after distribution of prescription guidelines, a cohort of attending hand surgeons at an academic institution decreased opioid prescription amounts after outpatient surgery.[23] The effect of prescription guidelines on reducing opioid overprescribing has been reproduced in larger studies as well, which makes a case for standardized guidelines to combat the opioid epidemic.[10,18,19] Postoperative overprescribing in the midst of an opioid epidemic stems from habits and incentives faced by prescribers.[7] As we see in this study, without intervention, the behaviors of providers who have completed training is less likely to adjust without formal intervention. Although the number of state and institutional guidelines and training requirements for attending-level providers has been increasing, the effect of these approaches on attending surgeon opioid prescription practices is an area for further study.

Limitations of this study were that the findings were from a single health system spread over 2 similar metropolitan areas, which potentially reduced transferability. Although concomitant procedures were excluded, we did not track the duration or complexity of procedures, which might influence opioid prescribing. Patient population within individual hospitals may also present a bias. Further analyses across additional hospital systems and regions may contribute to the findings. In addition, as with any policy-centered study, it is difficult to control for small differences in practice or provider awareness. However, our models helped control for patient- and provider-level factors that might confound our results, and there were no substantial state- or hospital-level policy changes over the 3 years studied.

Our study found that although both groups overprescribe, attending surgeons made less progress in reducing overprescribing. In contrast, without formal intervention, trainee overprescribing improved markedly over the study period. Considering that most change was seen at the trainee level, education for established providers may be an area in which more improvement can be made. Added focus on prescribers further removed from training years may be the next step in identifying ways in which surgeons can affect the opioid epidemic.

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