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No refills: The durable impact of a multifaceted effort by surgical trainees to minimize the prescription of postoperative opioids

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ABSTRACT

Background: Surgeons have the opportunity to help offset the opioid epidemic by leading with practice changes. We sought to decrease the amount of opioid prescribed postoperatively through a multifaceted program.

Methods: A multipronged program was introduced in our hospital system, which included resident education on prescribing for postoperative analgesia, a change in the default number of opioid pills in an electronic medication order entry system, and the distribution of a guideline card of recommended postoperative opioid prescription amounts. The amount of opioid prescribed postoperatively between January 2016 and August 2018 was collected for the 10 most common short-stay (<48 hours) general surgery procedures. The 6 months prior to any intervention (pre-intervention) was compared to the last 6 months of data collection (post-intervention).

Results: In the study, 14,007 operations were captured, including 2,530 pre-intervention and 2,715 post-intervention. The average amount of postoperative opioid prescribed in the pre-intervention period was 207.1 morphine milligram equivalents; post-interventions, the average amount declined to 104.6 morphine milligram equivalents ($P < .01$). The opioid refill rate remained the same (3.3% pre-intervention vs 3.1% post-intervention, $P = .76$).

Conclusion: A comprehensive program to eliminate the over-prescription of opioids decreased the amount of opioid prescribed by half, without a concurrent increase in opioid refills, demonstrating that simple measures can be used to deliver sustained and reproducible improvements in offering source control in the opioid epidemic.

Introduction

The opioid epidemic has had a significant impact on families and communities around the country. Although the problem is multifaceted, one significant and modifiable contributor to this national issue is the supply of opioid prescribed by medical providers to patients. Between 1999 and 2010, the number of opioid prescriptions written quadrupled; at the same time, there was a similar increase in the number of opioid related overdoses.[1] The field of surgery has been particularly entangled with this epidemic—over time, significantly more opioids have been prescribed for common surgical procedures and upwards of 90% of surgical patients are prescribed opioids in excess to their postoperative needs.[2–4] This is problematic, as even after minor surgery, there is a strong correlation between legitimate medical use of opioid and their subsequent persistent use or abuse.[5–9]

The ease of access to opioids has contributed significantly to the current epidemic, making its over-prescription a clear target for intervention.[2–4] Several highly publicized efforts at the federal level, led by the Surgeon General and the Centers for Disease Control and Prevention, have placed important spotlights and offered guidance on proper opioid use, particularly for the use of opioids in chronic pain.[10,11] Additionally, local governments have implemented measures to promote judicious opioid prescribing, including creating laws limiting prescription amounts, establishing state prescription drug monitoring programs, and alerting providers to individuals who may be doctor shopping for opioid prescriptions.[12–14] However, beyond national campaigns and state-wide policy, the role of the

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physician as the critical link between patients and communities as the providers of these medications has been relatively underemphasized.

Our group has previously shown that provider-level interventions can have success. Starting with a needs assessment survey, we demonstrated that external factors, such as assumptions regarding attending surgeons' preferences, and unexpectedly, the quantities of medications set as the default number in the electronic medication order entry system, influence resident prescribing. Additionally, the study showed that fewer than 10% of surgical residents were entering practice with training on postoperative analgesia management.[15] Based on these results, several targeted interventions were undertaken. We started by modifying the default numbers of pills set by the electronic medication order entry system, which profoundly impacted the behavior of prescribers.[16] After this, we introduced an educational program for trainees in which multimodal postoperative analgesia was emphasized and conscious and judicious opioid prescribing was urged.[17] Finally, we developed and implemented an evidence-based guide for pain control that provides rational recommendations for prescribing opioids after common general surgical procedures.

Although these initiatives proved to have an immediate successful impact, important questions remained after these interventions, including the durability of the results and whether the dramatic decrease in the number of pills initially prescribed simply translated into an increase in prescriptions refills. This study demonstrates the durability of the composite intervention, and that the prescription of opiates can be substantially reduced without resulting in increased medication refills.

Methods

Intervention timeline

The interventions described previously took place in a staged fashion during an 18-month period. The first step was the needs assessment survey of surgical housestaff, which was conducted in November of 2016.[15] Based on these results, the first intervention began in May of 2017: The change of the default number of pills offered to prescribers in the electronic medical record (EMR) system utilized by our hospital system from 30 pills of 5 mg oxycodone to 12 pills.[16] Next, in July of 2017 a curriculum was delivered to surgical trainees on multimodal analgesia, opioid pharmacology, and suggested regimens for common operations.[17] Finally, based on a comprehensive literature review and the consensus opinion of local surgeons from a variety of specialties, a guideline handout was created which contained evidence-based recommendations for opioid prescriptions; this was distributed in March of 2018.

Study population

To evaluate the composite impact of the interventions, postoperative opioid prescription amounts were abstracted from the EMR. Prescriptions from the 10 most common short stay (discharged within 48 hours) general surgery operations were collected among the three hospitals within our system that involved resident trainees (Table I). Data was limited to adult patients $\geq$18 years. Only patients discharged within 48 hours were included to avoid the potential confounder of complex hospital courses impacting analgesic needs. Data were retrospectively collected for operations taking place between January 1, 2016 through August 31, 2018.

Table I
Study demographics

Characteristic	Frequency	Percent
Sex		
Female	9,086	64.9
Male	4,921	35.1
Race/ethnicity		
White	9,906	70.7
Black	1,806	12.9
Hispanic	1,705	12.2
Asian	288	2.1
Unknown/other	302	2.2
Patient medical history		
History of chronic pain	903	6.5
History of substance abuse	576	4.1
History of chronic pain or substance abuse	1,413	10.1
Age (mean, SD)	53.9 (16.7)	
Operation		
Laparoscopic cholecystectomy	3,225	23.0
Partial mastectomy	2,611	18.6
Laparoscopic appendectomy	1,326	9.5
Laparoscopic inguinal hernia repair	1,279	9.1
Thyroidectomy	1,271	9.1
Parathyroidectomy	989	7.1
Open inguinal hernia repair	976	7.0
Laparoscopic sleeve gastrectomy	660	4.7
Open umbilical hernia repair	625	4.5
Total Mastectomy	465	3.3
Laparoscopic ventral hernia repair	313	2.2
Open ventral hernia repair	267	1.9
Prescriber level		
Resident	8,857	63.2
Advance practice provider	3,224	23.0
Attending	661	4.7
Fellow	641	4.6
Unknown	623	4.5
Total	14,007	100

Outcome measures

To understand the effect of our multifaceted approach to minimizing opiate prescriptions, we first sought to quantify the problem. Baseline prescribing practices were determined by evaluating the 6-month period prior to the academic year in which the initiatives began (January 1, 2016 through June 30, 2016). This was referred to as the pre-intervention period. Prescription amounts were converted into morphine milligram equivalents (MME) to standardize the amount of opioid across different medications. For reference, a single pill of 5 mg of oxycodone is equivalent to 7.5 MME.

The cumulative impact of the interventions over time was measured by comparing the average amount of postoperative opioid prescribed to patients during the pre-intervention period to the amount prescribed in the final 6 months of data collection, March 1, 2018 through August 31, 2018. This latter period was classified as post-intervention.

As there were concerns that these interventions may have changed behavior only to undertreat patient pain, prescription refill rates were additionally abstracted. In the state of Connecticut, all opioids are prescribed electronically, a requirement intended to prevent prescription diversion and doctor-shopping, which are both more difficult to monitor with paper-based prescriptions. If a patient received an additional opioid prescription within 30 days of their original prescription, they were categorized as needing a refill. All prescriptions written within the hospital system, including outpatient clinics, emergency rooms, and urgent care centers, were captured.

Variables

Patient demographics including age, sex, and race or ethnicity were abstracted, as was a documented patient diagnosis of chronic

Table II
Demographics of pre- and post-intervention cohorts

Characteristic	Pre-interventions		Post-interventions		*P* value
	Frequency	Percent	Frequency	Percent	
Sex					.27
Female	1,645	65.0	1,726	63.6	
Male	885	35.0	989	36.4	
Race/ethnicity					.11
White	1,791	70.8	1,945	71.6	
Black	310	12.3	336	12.4	
Hispanic	330	13.0	333	12.3	
Asian	37	1.5	56	2.1	
Unknown/other	62	2.5	45	1.7	
Medical history					
History of chronic pain	152	6.0	185	6.8	.23
History of substance abuse	123	4.9	115	4.2	.28
History of chronic pain or substance abuse	262	10.4	288	10.6	.77
Age (mean, SD)	55.0	16.5	53.5	16.8	<.01
Operation					
Laparoscopic cholecystectomy	590	23.3	624	23.0	.77
Partial mastectomy	466	18.4	484	17.8	.58
Laparoscopic appendectomy	227	9.0	285	10.5	.06
Laparoscopic inguinal hernia repair	196	7.8	271	10.0	<.01
Thyroidectomy	246	9.7	221	8.2	.04
Parathyroidectomy	189	7.5	204	7.5	.95
Open inguinal hernia repair	194	7.7	180	6.6	.14
Laparoscopic sleeve gastrectomy	134	5.3	114	4.2	.06
Open umbilical hernia repair	93	3.7	147	5.4	<.01
Total mastectomy	73	2.9	65	2.4	.27
Laparoscopic ventral hernia repair	73	2.9	54	2.0	.03
Open ventral hernia repair	49	1.9	66	2.4	.22
Prescriber level					
Resident	1,586	62.7	1,709	63.0	Resident
Advance practice provider	632	25.0	629	23.2	Advance practice provider
Attending	124	4.9	92	3.4	
Fellow	88	3.5	125	4.6	
Unknown	100	4.0	160	3.1	
Total	2,530		2,715		

pain or substance abuse, as these conditions could contribute to the amount of opioid required and prescribed. The type of prescriber was categorized as attending, fellow, resident, and advanced practice provider, which encompasses both advanced practice registered nurses and physician assistants.

Statistical considerations

All categorical values were compared utilizing the χ^2 test, while continuous variables were compared utilizing the Student *t* test. Medians were compared utilizing Wilcoxon rank-sum test. To measure the difference in prescribing between pre- and post-intervention groups, a linear regression of MME prescribed was calculated, controlling for patient factors and operation type. As the prescription amounts were not normally distributed, we performed an analysis of the type III sum of squares errors and the final model residuals; these did not demonstrate evidence of a biased sample.[18] All interventions were approved at the time of initiation by the Yale Human Investigations Committee.

Results

Demographics

Between January 1, 2016, and August 31, 2018, there were 14,007 adult short stay general surgery operations identified. The most frequent operations performed were laparoscopic cholecystectomy (23.0%), followed by partial mastectomy (18.6%), and laparoscopic appendectomy (9.5%). The operative population was majority female (64.9%) and white (70.7%), with an average age of 53.9 years (standard deviation [SD] 16.7). Residents wrote 63.2% of the postoperative prescriptions, advanced practice providers wrote an additional 23.0%, and the remainder were written by attending staff or fellows (Table I).

There were 2,530 operations performed during the pre-intervention period, compared to 2,715 operations in the post-intervention period. Comparing the pre- and post-intervention groups, there were no significant differences in the distribution of sex ($P = .27$), race or ethnicity ($P = .11$), or history of chronic pain or substance abuse ($P = .23$; Table II). The distribution of the types of operations performed were generally similar, although there were small, yet statistically significant differences (Table II).

Prescribing patterns

Pre-intervention prescribing

In the 6 months prior to any intervention, the average amount of opioid prescribed was 207.1 MME (SD 140.8; Table III). This average was fairly consistent by month during this period, providing a reliable baseline of the general prescribing patterns prior to any interventions (Fig 1). The range of prescription amounts varied widely, but for a majority of the operations, it was noted that the average amount prescribed was near 225 MME, or the equivalent of 30 pills of 5 mg oxycodone, the original EMR default (Fig 2).

Prescribing pattern after introduction of interventions

The first intervention was the change in default prescribing settings in the electronic medical record. An immediate drop in the average amount of opioid prescribed was noted after the

Table III
Opioid prescriptions and refill rates pre- and post-interventions

	Pre-interventions Frequency	Post-interventions Frequency	*P* value
Average amount prescribed (MME)			
Mean (SD)	207.1 (140.8)	104.6 (81.1)	<.01
Median (IQR)	200 (135–225)	90 (54–135)	<.01
Operations without an opioid prescribed	115 (4.6%)	202 (7.4%)	<.01
Opioid refills within 30 days	83 (3.3%)	85 (3.1%)	.76
Total	2,530	2,715	

IQR, interquartile ratio.

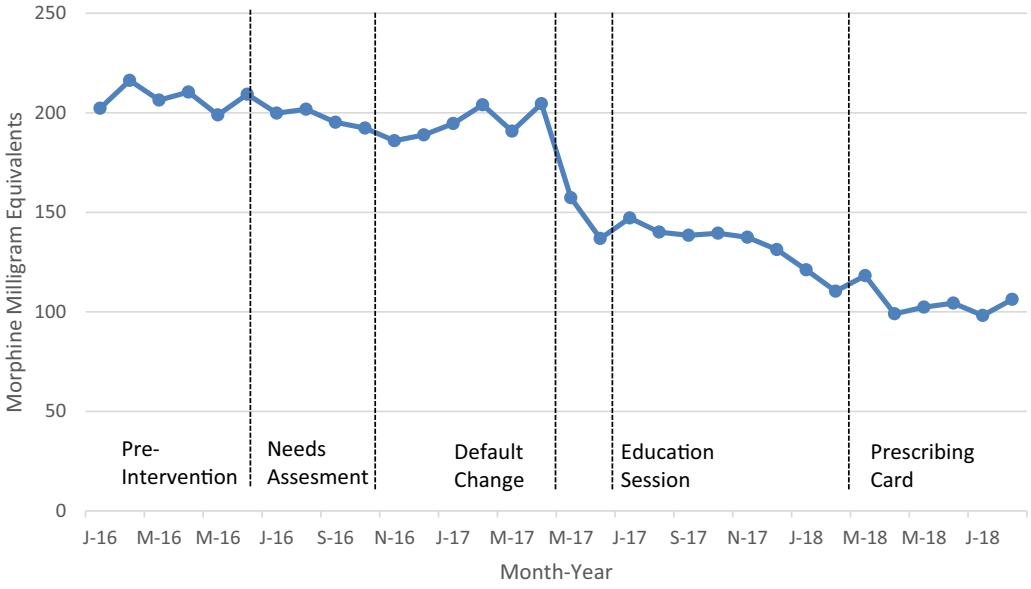


Fig 1. Average amount of opioid (in MME) per prescription by month.

introduction of this change (Fig 1). The average amount of opioid per prescription in the month following the change was 157.4 MME, down from 204.5 MME in just the month prior. A modest but continued decrease in the average amount prescribed post-operatively was noted in the months after the initiation of the education session, with further decrease seen after the distribution of the prescribing guideline card (Fig 1).

Comparing the prescribing practices during the post-intervention period compared to the pre-intervention period, there was a significant decrease in the average prescription from 207.1 MME to 104.6 MME ($P < .01$; Table III). There was a statistically significant decrease for every operation studied, except open ventral hernia. The largest decreases in average opioid prescription amounts were seen for laparoscopic appendectomy (−168.0 MME), laparoscopic inguinal hernia (−138.1 MME), and laparoscopic cholecystectomy (−135.1 MME; Fig 2).

Linear regression controlling for patient demographics and type of operation demonstrated that the average prescription in the post-intervention time frame was 103.2 MME less than in the pre-intervention period, or the equivalent of a decrease of nearly 14 pills of 5 mg of oxycodone (Table IV). There was no difference in prescription amounts based on sex or race or ethnicity. Older patients were prescribed significantly less opioid, with an average decrease of −0.4 MME per year increase in patient age.

Cumulative impact

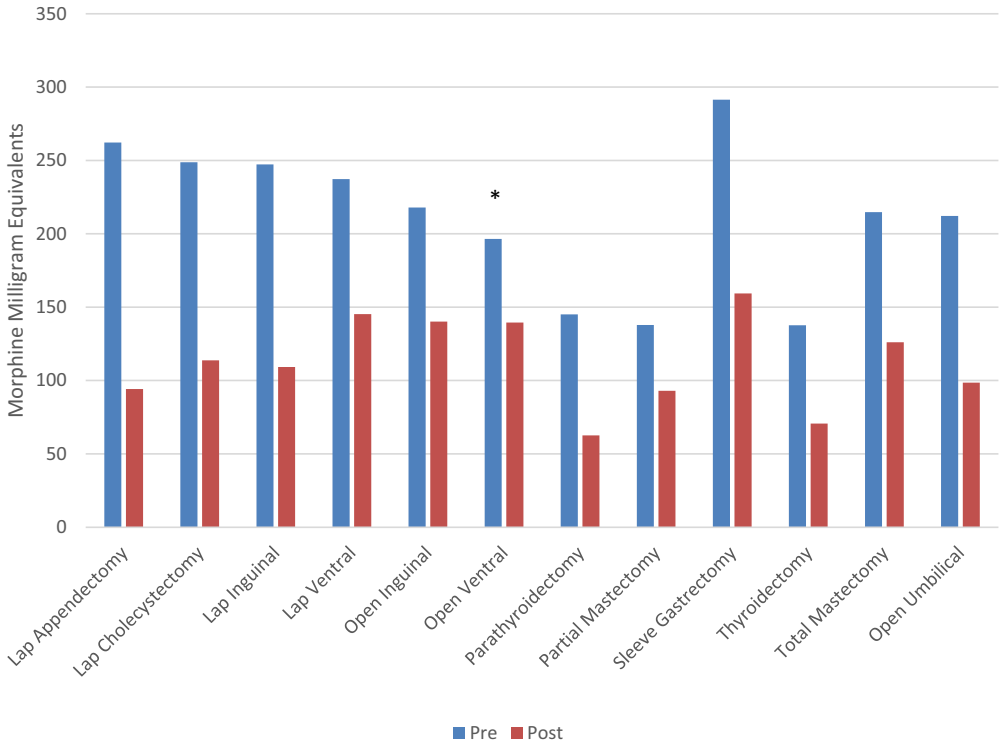
In the pre-intervention era, the average amount of opioid prescribed per month was 87,328 MME, or the equivalent of 11,644 pills of 5 mg of oxycodone. In comparison, by the end of the data collection period, the amount of opioid prescribed had decreased by more than the equivalent of 5,000 fewer pills of 5 mg oxycodone per month. If prescribing had continued at the original pre-intervention rate, 2,270,528 MME would have been prescribed during the entire study period, compared to the 1,730,248 MME that was actually prescribed. This 540,280 MME difference is the equivalent of 72,037 fewer pills of 5 mg oxycodone prescribed over the 16 months since the first intervention was initiated.

Refill rates

Although the amount of opioid decreased significantly, there was not an increase in opioid refills as feared. The refill rate in the pre-intervention era was 3.3% compared to 3.1% in the post-intervention era ($P = .76$; Table III).

Discussion

Through a series of simple interventions (an analgesia curriculum, a guideline card, and a change to the electronic order entry system), opioid prescriptions were reduced by 50%, from the equivalent of 28 pills of oxycodone per prescription to 14. This effect was observed to be durable during a period of over a year and a half. Changes to the order entry system seem to have had the most significant direct impact; however, the training and guidelines on the topic served to boost awareness and provide a rational framework for judicious prescribing



*all p<0.05 except for open ventral hernia

Fig 2. Average amount of opioid prescribed (MME) by type of operation.

Table IV
Linear regression of the amount of postoperative opioid prescribed (in MME)

Parameter	Estimate	95% confidence limits		*P* value
Intercept	256.8	242.5	271.1	<.01
Intervention period				
Post-intervention	−103.2	−109.1	−97.3	<.01
Pre-intervention	Ref	Ref	Ref	—
Age	−0.4	−0.6	−.2	<.01
Sex				
Female	−9.5	−17.2	−1.8	.02
Male	Ref	Ref	Ref	
Race/ethnicity				
Asian	4.7	−17.6	27.0	.68
Black	1.5	−7.7	1.7	.75
Hispanic	5.7	−3.6	15.0	.23
Unknown/other	14.7	−6.1	35.5	.17
White	Ref	Ref	Ref	
History of substance abuse				
Yes	16.1	1.9	3.3	.03
No	Ref	Ref	Ref	—
History of chronic pain				
Yes	4.1	−8.2	16.4	.52
No	Ref	Ref	Ref	—
Type of operation				
Appendectomy	−11.5	−22.9	.0	.05
Lap inguinal hernia	−5.9	−18.7	6.8	.36
Lap ventral hernia	9.3	−10.6	29.2	.36
Open inguinal hernia	−1.6	−15.2	12.0	.82
Open ventral hernia	−7.4	−28.2	13.3	.48
Parathyroidectomy	−69.2	−81.9	−56.6	<.01
Partial mastectomy	−57.4	−67.2	−47.7	<.01
Sleeve gastrectomy	44.3	29.4	59.2	<.01
Total thyroidectomy	−74.4	−86.2	−62.7	<.01
Total mastectomy	−3.6	−22.9	15.7	.71
Umbilical hernia	−29.6	−44.8	−14.3	<.01
Lap cholecystectomy	Ref	Ref	Ref	—

habits. These additional efforts continue to help drive down excess prescriptions well after the default settings were decreased.

A potential unintended effect of decreasing opioid prescriptions might be an increase in the number of medication refills, suggesting that minimized prescriptions would be insufficient for some patients. To the contrary, we found that the interventions did not lead to an increase in the rate of medication refills. In fact, the post-intervention refill rate actually decreased slightly, although this difference was not statistically significant. This observation lends credence to the idea that adequate analgesia can be achieved with a dramatically lower quantity of pills than has recently been conventional. The fact that refills did not increase may also reflect a change in the general discourse in the instructions given to patients at the time of their hospital discharge. Providers are now trained to encourage patients to use nonopioid as a substitute for opioids in appropriate circumstances. Indeed, the number of patients discharged without an opioid analgesic increased from 4.6% to 7.4% ($P < .01$, Table III).

The simplicity of the interventions should not be underemphasized. Our approach required no additional funding and could easily be replicated in a variety of settings. Harnessing electronic order entry systems is a profoundly impactful way to alter the behavior of prescribers. Other groups have demonstrated the effect of modifying electronic defaults on prescribing habits in different contexts, and new opportunities to further employ modest, but rational, presets and defaults should be exploited.[19] Furthermore, as evidence-based postoperative analgesia guidelines and pain management curricula gain widespread acceptance, sharing them in convenient and tangible ways with surgical trainees will represent another simple and low-cost measure with significant returns.[20]

This study also demonstrated the importance of incorporating quality improvement (QI) projects into residency training. Our study uniquely highlights the different perspective that trainees can bring to QI problems. At our institution, residents and advanced practice providers write nearly 90% of all postoperative opioid prescriptions; anecdotally, many surgical attendings have not actually prescribed a controlled substance in years. Given infrequent prescribing by attending surgeons, issues such as prescription defaults are more apparent to the residents actually writing the prescriptions. Additionally, this project shows that resident-led QI can have a considerable and substantive impact on patient care and communities at large. Developing QI projects remains a core requirement from the Accreditation Council for Graduate Medical Education, and the value of this requirement should be highlighted in surgical training programs. Beyond developing the knowledge and skills essential for modern physicians, it is imperative that trainees become empowered to identify and correct problems in clinical processes.

Finally, this initiative, from our team and similar work from those around the country, demonstrate the role that surgeons can play in public health and societal issues.[21,22] Although excellence in the operating room is an expectation, a surgeon's role in patient care should not stop there; surgeons must engage in the broader context of patient disease and discussions of their communities.[23] The opioid epidemic is just one of the countless ways surgical care naturally incorporates into community health. For years surgeons have tackled public health matters including firearm safety, accident prevention, cancer screening, and disparities in healthcare.[24–26] Surgeons must continue to evaluate how surgical practice can impact the community at large.

Our study has a number of limitations. First, it was conducted within a single hospital system, and results may not be applicable to all institutions, particularly those without an EMR. Second, this was not a controlled study, and there are several other factors that may have influenced prescribing. For example, the nationwide attention paid to the opioid epidemic may have influenced prescribers' behavior even without intervention. Additionally, our data on refill rates is limited as we only had access to information from within in our health system, potentially underestimating refills prescribed by outside providers.

In conclusion, a comprehensive program targeted at responsible postoperative analgesia decreased opiate prescriptions by half in a sustained manner and did not result in a higher rate of refills. This work shows that simple, low cost measures can significantly decrease the number of opioid pills prescribed in excess of patient analgesic need, helping to minimize the chance of chronic use, misuse, or diversion for illicit purposes. Surgeons must acknowledge their roles in the societal problem of opioid abuse and act on the opportunities that can deliver durable and meaningful improvements.

Conflict of interest/Disclosure

All authors agree to the contents of this manuscript and have no conflicts of interest to disclose.

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