



Temporal trends in opioid prescribing for common general surgical procedures in the opioid crisis era



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ABSTRACT

Background: Recent data has demonstrated that postoperative patients are at risk of chronic opioid abuse. It is unknown whether surgeon postoperative opioid prescribing changed as the opioid crisis entered its peak.

Methods: The Institutional Data Warehouse was queried to identify patients who underwent three common elective ambulatory procedures between 2014 and 2018 ($n = 3495$), including: laparoscopic cholecystectomy, laparoscopic inguinal hernia repair (IHR), and open IHR. The main outcome of interest was opioid pills prescribed, converted to an equianalgesic pill number (1 pill = 5 mg oxycodone).

Results: Postoperative opioid prescribing was stable from 2014 to 2016 then decreased significantly in 2017 and 2018 ($p < 0.0001$). While the median number of pills prescribed remained stable at 30 between 2014 and 2018, the frequency of patients receiving 30 pills decreased significantly. Multivariate analysis demonstrated significantly fewer pills prescribed postoperatively after 2016.

Conclusions: Reductions in postoperative pills prescribed over time as the opioid crisis worsened suggests that surgeons may be considering the potential for opioid abuse and diversion. Persistently high median number of pills prescribed and continued variation in number of pills prescribed suggests room for further improvement.

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Introduction

In 2016 there were 63,632 deaths related to opioid overdose, representing a 4-fold increase from 1999. Provisional data from 2017 suggests that this rate has continued to rise significantly, emphasizing the importance of urgent intervention.^{1,2} The roots of the present crisis lie in prescription opioid medication. Opioid prescribing quadrupled from 1999 to 2010, when a staggering 81.2 opioid prescriptions were written per 100 persons.³ This is enough medication to supply every adult American with 5 mg of hydrocodone every 6 hours for 45 days.⁴ The rate of deaths from prescription opioid-related overdose increased in parallel with the upward trend in opioid prescriptions, reaching a current rate of over 19,000 deaths per year.²

Opioid prescribing by surgeons may have the potential for both a direct and an indirect impact on prescription opioid abuse.

Surgery may represent the first time many patients are prescribed an opioid medication. Between 2007 and 2012, 37% of the 289 million opioid prescriptions dispensed were from surgeons, second only to pain medicine specialists (49%).⁵ Surgical patients who receive postoperative opioid medication have a 3–7% risk of becoming a chronic opioid user.^{6–8} Furthermore, up to 70% of chronic users receive medication through diversion, often through friends or family with a prescription.^{9,10} It has been demonstrated that 67–92% of patients prescribed postoperative opioids report high amounts of unused medication, with less than 10% following proper US Food and Drug Administration recommended disposal methods.¹¹ Surgeons are challenged by the need to balance adequate treatment of acute pain with concerns regarding potential for abuse.

There is a paucity of data pertaining to the impact of the opioid crisis on opioid prescribing among surgeons. Until recently, limited guidelines for treatment of postoperative pain left the decision of how much opioid to prescribe up to the providing surgeon. Studies have demonstrated wide variation in postoperative opioid prescribing, suggesting room for improvement through provider

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education and treatment standardization.^{12,13} However, no study to date has examined the trends in prescribing patterns during the era of the opioid crisis.

To further improve understanding of opioid prescribing among general surgeons as the opioid crisis has continued to expand, we analyzed trends in postoperative opioid prescribing practices at a single, large academic medical center between 2014 and 2018.

Methods

A retrospective cohort study was conducted using the Mount Sinai Data Warehouse to identify all patients that underwent the 3 most common elective ambulatory procedures performed at our institution between 2014 and 2018 and received an opioid prescription, including: laparoscopic cholecystectomy, laparoscopic inguinal hernia repair and open inguinal hernia repair. Changes in postoperative opioid prescribing were compared between study years.

Postoperative opioids included opioid medication prescribed within the 30-day perioperative period. Postoperative opioid prescriptions were categorized and quantified by medication type and number of pills. The number of pills prescribed was converted to an equianalgesic equivalent with one pill corresponding to 5 mg of oxycodone to achieve a standardized comparison between opioid medication types.¹² Demographic variables studied include age at surgery, gender, year of surgery, surgery length, and attending surgeon. Attending surgeon gender and years in practice (1–5, 6–10, 11–20, and 21+) were also recorded.

To minimize confounding associated with larger surgeries, inpatient intravenous opioid usage, and patients with more complex disease processes that may require additional analgesic medications, we did not include inpatient procedures. Furthermore, only cases performed by surgeons that performed ≥ 50 cases during the study period were included.

Descriptive data, including the number of opioid pills prescribed, are reported as median (interquartile range) and range (minimum, maximum). To evaluate change in median opioid pills prescribed during the study period, the Kruskal-Wallis test was used. Post-hoc analysis was performed using the Wilcoxon rank sum test to perform pair-wise comparisons of pills prescribed by study year. Mixed linear regression analysis was performed to account for the correlation between attending surgeon and number of pills prescribed. Multivariate analysis was performed to control for potential confounders that may impact the number of opioid pills prescribed. Statistically significant factors on univariate analysis were included in the multivariable model. Two-sided p value < 0.05 was considered statistically significant. All data analyses were performed using SAS v9.4 (SAS Institute, Carey, North Carolina).

Results

There were 3495 patients identified that met the inclusion criteria. Descriptive statistics are given in Table 1. In total, the distribution of procedures was as follows: 1524 (44%) laparoscopic cholecystectomy, 1044 (30%) laparoscopic inguinal hernia repair, and 927 (26%) open inguinal hernia repair. There were 2503 (72%) men and 992 (28%) women. The median age of included patients was 55 years (IQR 39–68). The most commonly prescribed opioid was oxycodone.

There were 20 attending surgeons that performed surgery during the study period. The majority were male (18/20). There were 4 (20%) surgeons in practice for 1–5 years, 6 (30%) for 6–10 years, 6 (30%) for 11–20 years and 4 (20%) with 21+ years.

The distribution of number of opioid pills prescribed by surgery

Table 1
Characteristics of included patients.

Characteristic	N (%)
Median Age , years (IQR)	55 (39–68)
Gender	
Male	2128 (61)
Female	1367 (39)
Median Operative Time , minutes (IQR)	69 (55–87)
Procedure Type	
Laparoscopic Cholecystectomy	1524 (44)
Laparoscopic Inguinal Hernia Repair	1044 (30)
Open Inguinal Hernia Repair	927 (26)
Surgery Year	
2014	759 (22)
2015	778 (22)
2016	728 (21)
2017	808 (23)
2018	422 (12)

year is given in Fig. 1. There was no significant change in opioid prescribing in 2015 (median 30, IQR 30–30) or 2016 (30, 30–40) from the start of the study in 2014 (30, 30–30); however, there was a significant reduction in 2017 (30, 23–30) and 2018 (30, 20–30) ($p < 0.0001$). The median and mode were 30 pills across all study years. However, as demonstrated in Table 2, the number of patients that received 30 pills or > 30 pills decreased significantly over time.

There was wide variation in the overall number of pills prescribed 130 (min 2, max 132). Among patients that received a prescription refill, the overall median number of pills was 60, and ranged from 10 to 132 while among those without a refill, the median was 30 with range 2–120. There was minimal change in range between 2014 and 2017 (113–130); however, in 2018 the range decreased to 75. As demonstrated in Fig. 2, there was a wide range in number of pills prescribed for all included procedures by year. Fig. 3 demonstrates the variation in pills prescribed by attending.

The results of the mixed linear regression model with correlation by attending surgeon are presented in Table 3. Univariate analysis demonstrated that female gender, 11–20 years in practice and surgery in 2017 and 2018 predicted a lower number of opioid pills prescribed. Open inguinal hernia repair, longer operative time and 21+ years in practice predicted an increased number of opioid pills prescribed. Multivariate analysis demonstrated that female patients ($\beta -1.59$, $p = 0.012$) and patients of surgeons in practice for 11–20 years ($\beta -2.12$, $p = 0.004$) received approximately 2 pills fewer than others. Furthermore, as compared to 2014, patients that underwent surgery in 2017 received approximately 4 pills fewer ($\beta -3.785$) and in 2018, 7 pills fewer ($\beta -7.25$) ($p < 0.0001$).

Discussion

This study examined changing trends in postoperative opioid pills prescribed during the period between 2014 and 2018 in a large single institutional cohort. This is the only study to date that we know of to examine temporal changes in opioid prescribing for common general surgical procedures. Although a significant decrease in pills prescribed was observed over the course of the study period, our results suggest that opioid prescribing remains relatively high with significant room for improvement.

The significant decrease in pills prescribed over the study period may reflect growing awareness among clinicians regarding the risks associated with opioid use. It is interesting to note that nationally opioid prescribing amounts appeared to peak in 2010, and then decreased somewhat while a downward trend appeared to occur in 2016 in our series.³ This may be secondary to changes in perceptions of risk for opioid abuse. Most opioids are prescribed by

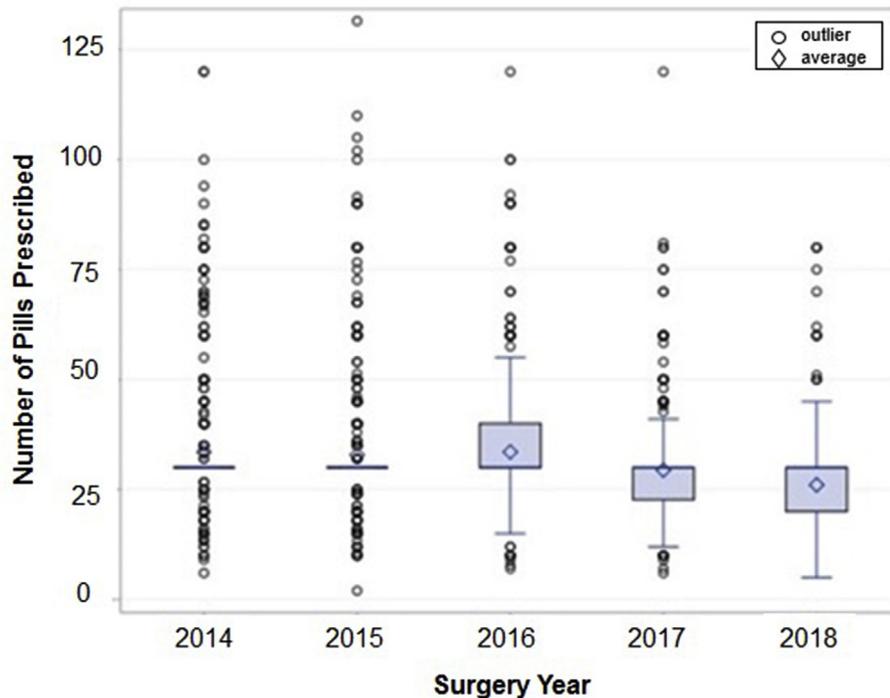


Fig. 1. Boxplot of pills prescribed by year, all procedures. (The median, or 50th percentile, is represented by the line within the box. The 25th percentile and 75th percentile are represented by the upper and lower boundaries of the box. The upper and lower whiskers represent observations outside of the middle 50% of observations. Outliers, as calculated by the statistical program, are presented as open circles).

pain management physicians for chronic pain whereas post-operative opioid medications are given to treat acute pain. However, numerous subsequent studies have demonstrated the risk of opioid abuse in postoperative patients.^{6–8}

Interestingly, although there was a downward trend in pills prescribed, the median and mode remained constant at 30 during the study period. This is likely the result of the default prescription in the electronic medical record, which was 30 at our institution. Chiu et al. recently demonstrated that after changing the default number of opioid pills at their institution, the percentage of patients receiving 30 pills decreased from 40% to 13%.¹⁶ Our study demonstrated that even without changing the default number of pills in the electronic medical record, the percentage of patients that received 30 pills decreased over the study period.

There was a wide range of pills prescribed for these procedures over the study period, although it decreased somewhat in 2018. Although no other study has evaluated trends over time, previous data has similarly demonstrated a wide variation in number of pills prescribed.^{12,14,15} In a single-institutional review of 700 patients undergoing 5 common surgical procedures at a single institution in 2015, Hill et al. demonstrated the largest variation for laparoscopic cholecystectomy (0–100) and open inguinal hernia repair (15–120).¹² In our series, we demonstrated a similar wide range across all procedures. Given that we included prescriptions written

within 30 days of surgery, it is possible that the wide range may be in part related to patients receiving a prescription refill; however, fewer than 10% of patients received a refill which implies that these patients alone do not explain the observed range. Rather, it is more plausible that a combination of individual practice and increased understanding of the opioid crisis contribute to the observed decline.

Our multivariate model demonstrated that after controlling for factors that may influence number of pills prescribed, patients that had surgery in 2017 and 2018 received significantly fewer pills. This highlights the potential impact that the opioid crisis has had on prescribing. Furthermore, surgeons with 11–20 years of experience prescribed fewer pills. A possible explanation may be increased experience. Although we did not demonstrate a significant difference in surgeons with 21+ years of experience, the positive trend observed suggests that longer time in practice may be associated with reduced willingness to change practice. While the etiology of these observations may be multifactorial, it suggests that different attendings may consider the risks of abuse and diversion differently and that there is a lack of clear understanding of postoperative pain requirements by prescribers.

Differences in prescribing amongst attendings and between procedures highlight lack of clear recommendations and education on postoperative pain management. Furthermore, studies have

Table 2
Change in distribution of patients that received 30 pills over time.

Number of Pills Prescribed	Surgery Year, N (%)					P Value
	2014	2015	2016	2017	2018	
<30	117 (15)	128 (16)	113 (16)	227 (28)	201 (48)	<.0001
30	457 (60)	472 (61)	408 (56)	448 (56)	186 (44)	
>30	185 (24)	178 (23)	207 (28)	133 (16)	35 (8)	

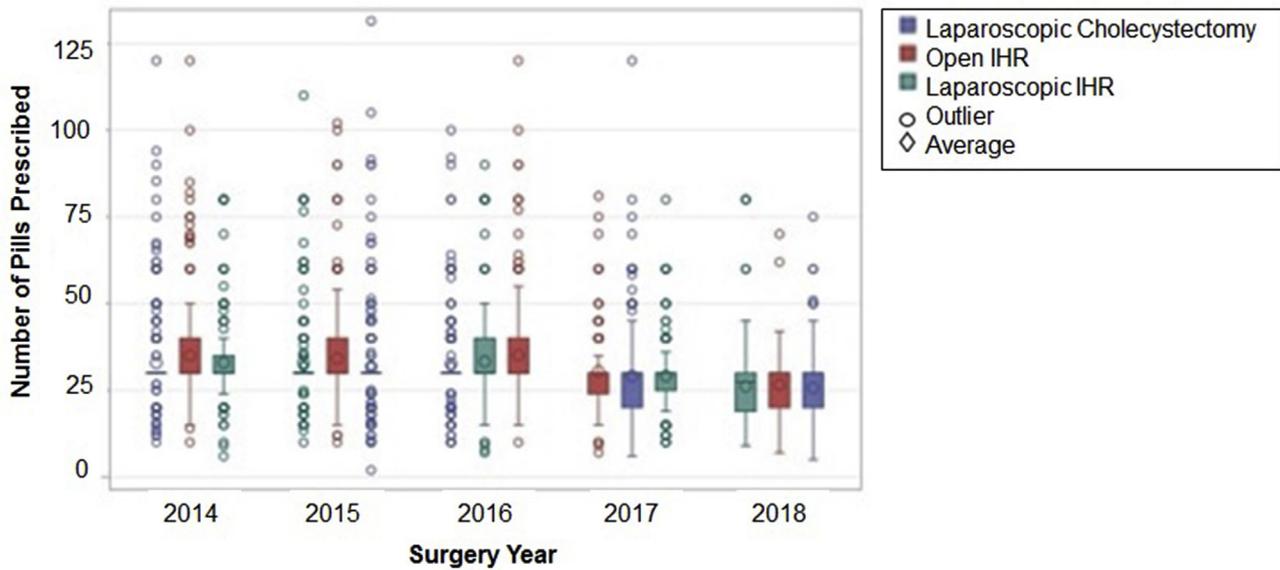


Fig. 2. Boxplot of pills prescribed by procedure and year (IHR = inguinal hernia repair; The median, or 50th percentile, is represented by the line within the box. The 25th percentile and 75th percentile are represented by the upper and lower boundaries of the box. The upper and lower whiskers represent observations outside of the middle 50% of observations. Outliers, as calculated by the statistical program, are presented as open circles).

demonstrated that most opioid pills prescribed postoperatively go unused suggesting a disconnect between understanding of post-operative pain and prescribing habits.^{11,12} National guidelines previously listed best practices for pain management without detailed guidance on how many pills are appropriate to prescribe.¹³ Recent data quantifying the “optimal” number of opioid medications to administer based on procedure type have resulted in the release of guidelines on ideal prescribing for selected surgeries from the Opioids After Surgery Workshop.^{12,13,17} The guidelines recommend the following ideal ranges of pills (in 5 mg oxycodone tablets) for the

procedures included in this study: open inguinal hernia repair (0–10), laparoscopic inguinal hernia repair (0–15), and laparoscopic cholecystectomy (0–10).

To date, studies evaluating the impact of guidelines for post-operative opioid prescribing have demonstrated significant reductions in overprescribing without impacting patient satisfaction with pain control.^{10,18} When comparing the recommended pill numbers to those of the current study, there remains significant room for improvement. Currently, our institution does not have a protocol in place and thus the observed changes reflect the impact

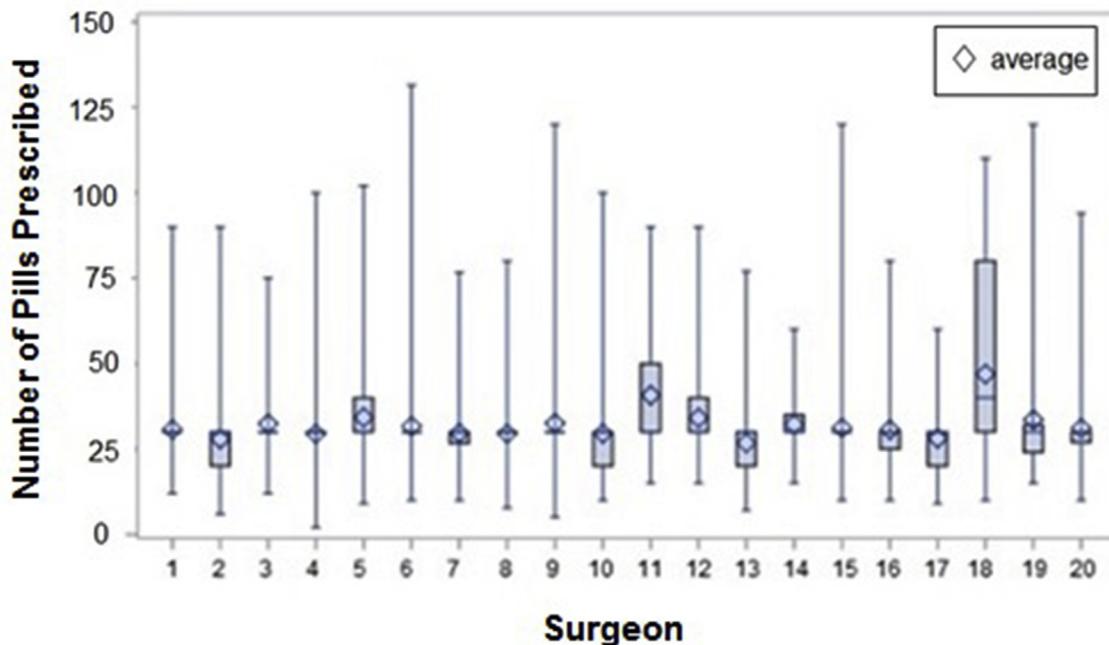


Fig. 3. Boxplot of pills prescribed by surgeon. (The median, or 50th percentile, is represented by the line within the box. The 25th percentile and 75th percentile are represented by the upper and lower boundaries of the box. The upper and lower whiskers represent observations outside of the middle 50% of observations).

Table 3
Univariate and multivariate mixed linear regression analysis of factors that influence opioid prescribing.

	Univariate		Multivariate	
	Parameter Estimate (SE)	P Value	Parameter Estimate (SE)	P Value
Age, years	0.007 (0.012)	0.601		
Gender				
Male	Ref		Ref	
Female	−1.936 (0.439)	0.0003	−1.592 (0.569)	0.0115
Procedure				
Laparoscopic Cholecystectomy	Ref		Ref	
Laparoscopic IHR	0.738 (0.512)	0.160	−0.522 (0.623)	0.408
Open IHR	2.34 (0.533)	0.0001	0.892 (0.631)	0.168
Operative Time, minutes	0.0162 (0.008)	0.0481	0.007 (0.008)	0.390
Surgeon Gender				
Male	Ref			
Female	−0.388 (0.512)	0.458		
Surgeon Years in Practice				
1–5	Ref		Ref	
6–10	−0.559 (0.594)	0.361	−1.127 (0.579)	0.069
11–20	−1.634 (0.646)	0.022	−2.121 (0.625)	0.0037
21+	2.672 (0.942)	0.012	1.249 (0.920)	0.194
Surgery Year				
2014	Ref		Ref	
2015	−0.678 (0.641)	0.294	−0.661 (0.631)	0.298
2016	−0.0543 (0.654)	0.934	0.161 (0.647)	0.804
2017	−4.062 (0.635)	<.0001	−3.785 (0.632)	<.0001
2018	−7.466 (0.760)	<.0001	−7.249 (0.755)	<.0001

of current events and attending preferences alone without intervention. In the future, we intend to use these results to develop our own opioid stewardship educational program and implement a prescribing protocol. Future research may consider evaluation of patient factors that limit use of protocols and obstacles to protocol adherence by attendings.

This large serial cross-sectional study is unique in that temporal trends in opioid prescribing were observed. This study has several limitations. First, the current practice at our institution is for attendings to determine the type and number of opioids prescribed postoperatively even if a resident was the prescriber. However, it is possible that in some situations the resident selected the type and quantity of medication prescribed independent of the surgeon. Second, only patients who were prescribed opioids were included. However, we believe that there is minimal risk of selection bias because of this as the common practice at our institution during this time period was to write for opioids for all patients. As such, nearly all patients that underwent ambulatory procedures during the study period were included.

Postoperative opioid prescribing has decreased over time as the opioid crisis has worsened, however, median opioid prescribing has remained high with improving but persistent wide variation in number of pills prescribed. This study highlights the importance of educational interventions and clinical protocols to impact further reduction and serves as a baseline for prospective assessment of the impact of such actions.

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Conflicts of interest

The authors have no relevant conflicts of interest to disclose.

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