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Post-Discharge Opioid Prescribing and Use after Common Surgical Procedures

Mayo H Fujii, MD MS[a,b], **Ashley C Hodgesm, BA BS**[b], **Ruby L Russell, BA**[b], **Kristin Roensch, MD**[c], **Bruce Beynnon, PhD**[b], **Thomas P Ahern, PhD MPH**[b], **Peter Holoch, MD**[a,b], **Jesse S Moore, MD FACS**[a,b], **S Elizabeth Ames, MD**[b,c], and **Charles D MacLean, MD**[b]

[a]Department of Surgery, University of Vermont Medical Center, Burlington, VT

[b]University of Vermont Larner College of Medicine, Burlington, VT

[c]Department of Orthopaedics, University of Vermont Medical Center, Burlington, VT

Abstract

BACKGROUND—The number of deaths from prescription opioids in the United States continues to increase and remains a major public health concern. Opioid-related deaths parallel prescribing trends and post-operative opioids are a significant source of opioids in the community. Our objective was to identify opioid prescribing and use patterns after surgery to inform evidenced-based practices.

STUDY DESIGN—Data from a 340-bed academic medical institution and its affiliated outpatient surgical facility included: 1) retrospective medical record data, 2) prospective telephone questionnaire and medical record data. Retrospective data included patients discharged after 19 procedures types from July 2015–June 2016 (n=10,112). Prospective data included a consecutive sample of general and orthopaedic surgery, and urology patients undergoing one of 13 procedures from July 2016–February 2017 (n=539). Primary outcomes were the quantity of opioid prescribed and used in morphine milligram equivalents (MME), and the proportion of patients receiving instructions on disposal and non-opioid strategies.

RESULTS—In the retrospective dataset, 76% of patients received an opioid after surgery and 87% of prescriptions were prescribed by residents or advanced practice providers. Median prescription size ranged from 0–503 MME with wide interquartile ranges (IQR) for most procedures. In the prospective dataset, there were 359 participants (67% participation rate). Of these, 92% of patients received an opioid and the median proportion used was 27%, or 24 MME (IQR 0–96). Only 18% of patients received disposal instructions, while 84% of all patients received instructions on non-opioid strategies.

Corresponding Author Address: Mayo H Fujii, MD MS, University of Vermont Medical Center, Box 341, 111 Colchester Avenue, Burlington, VT 05401, Phone: 802-779-2493, mayo.fujii@uvmhealth.org.

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CONCLUSIONS—Median opioid use after surgery was 27% of the total prescribed and only 18% of patients reported receiving disposal instructions. Significant variability in opioid prescribing and use after surgery warrants investigation into contributing factors.

Keywords

postoperative pain; opioids; drug utilization; surgical procedures; prescribing patterns

Introduction

The number of deaths from prescription opioids in the United States continues to increase (1) and remains a major public health concern despite evidence that preventative measures and more conservative prescribing efforts can curtail this trend (2). Between 1999 and 2008 the opioid overdose death rate increased four-fold as opioid pain reliever sales increased (3). Several studies have outlined other risks of prescription opioid use. These include opioid dependence or prolonged opioid use after taking opioids for acute (4) or post-operative pain (5–8), as well as prescription opioid abuse leading to heroin use (9–11).

State resources and education efforts such as the 2016 Centers for Disease Control and Prevention (CDC) prescriber guidelines on safe and effective opioid prescribing have largely been focused on chronic pain and substance abuse treatment (12). Recent studies have shown that opioid prescribing for acute pain, particularly in the post-operative setting, remains a significant source of opioids in the community. More specifically, they have demonstrated that there is considerable variability in the amount prescribed after routine procedures (13–15), that the amount prescribed after these procedures has increased over time (14), and that patients generally use much less opioid medication than they are prescribed (15–20). However, many of these studies are limited by small sample size, findings expressed in number of pills or proportions rather than morphine milligram equivalents (MME), and reliance on patient recall of medication use weeks to months after surgery. Furthermore, the utility of findings on opioid use after surgery tend only to be generalizable in relation to the specific procedures studied and thus there remains a gap in the literature regarding many procedures.

The purpose of this study was to collect prospective data in the immediate post-operative period after common surgical procedures across multiple surgical specialties. Our specific aims were: 1) to describe current prescribing practices at discharge from surgery, and 2) to determine patient-reported opioid use after surgery. Our broader clinical goal is to inform evidence-based practices that provide effective post-operative pain management while minimizing the amount of unused opioid medication in the community.

Methods

Study design

This study involved two different datasets and methods of data collection. The first, a retrospective review of prescribing patterns was used to inform the second, a prospective telephone questionnaire and chart review focusing on opioid use after surgery.

Retrospective review of prescription data—We collected data on opioid prescriptions written at the time of discharge after inpatient or outpatient surgical procedures over a one-year period (July 1, 2015–June 30, 2016). These dates were chosen to coincide with the academic calendar to ensure that resident clinical level would remain consistent over the course of data collection.

Prospective telephone questionnaire and chart review data—We then conducted a prospective telephone questionnaire and chart review of patients approximately one week after discharge from a surgical procedure. We designed a telephone questionnaire with input from a committee of surgeons and researchers, as there is no validated instrument available in the literature to address our aims. Data collection took place between July 2016 and February 2017 and patients were recruited in a staggered fashion with additional procedures added over time. We recruited patients using our operating room scheduling system and contacted each patient by telephone five to seven days after discharge from their surgical procedure. A total of four attempts were made over two days at different times of day to maximize the likelihood of patient contact.

If patient contact was made, a 10-minute telephone questionnaire was conducted inquiring about discharge instructions received on pain management and medication disposal, whether an opioid was prescribed, and how much of the opioid medication was used. A verbal count of the number of remaining pills was obtained from the patient whenever possible, as well as consent to review their medical record for details about their opioid prescription history, surgery and post-operative recovery. If patients were still using the prescribed medication at the initial telephone call, a second call was made one week later to determine the total amount of pain medication used. If patient consent was obtained, a chart review was performed.

Data were collected and managed using REDCap electronic data capture tools hosted at the University of Vermont (21).

Setting and Patients

The study was carried out in a 340-bed academic medical center and its affiliated outpatient surgery facility, which includes 14 surgical specialties and an annual surgical volume of approximately 20,000 cases. We obtained a waiver of consent for the collection of data in the retrospective dataset and limited data in the prospective dataset. All patient information gathered prior to patient consent in the prospective dataset were limited to certain details necessary to identify, screen, and contact patients to participate in the study. At the time of telephone contact, consent was obtained to collect the remainder of the data from the prospective dataset, including opioid prescription and post-operative recovery details. Both study protocols were approved by the University of Vermont Institutional Review Board Committee on Human Research in Medical Settings.

Retrospective review of prescription data—We included patients 18 years and older who were discharged to home after one of 19 procedures in general surgery, orthopaedic surgery, urology, and gynecology, during the study period. Patients discharged to a skilled

nursing or rehabilitation facility were excluded under the assumption that post-operative pain control would be managed by a provider other than the surgeon or surgery team.

Prospective telephone questionnaire and chart review data—We obtained a consecutive sample of patients who underwent one of 13 common procedures in general surgery, orthopaedic surgery, or urology during the recruitment period. The selection of procedures for each surgical specialty was based on the most commonly performed procedures at our institution (identified during the retrospective prescription database review) and specifically included a range of invasiveness and anticipated post-operative pain. We screened patients by their procedure listed in the scheduling system only for those surgeons who agreed to have their patients called as part of the study. Gynecology procedures were not included in this portion of the study due to resource limitations.

Exclusion criteria at enrollment were bilateral or multiple procedures performed at the same time, repeat procedure, recent procedure (within the last month), known malignancy, under the age of 18, urgent or emergent procedure (other than appendectomy), and previous enrollment in the study. Patients who underwent partial mastectomy for malignancy were exempt from the malignancy exclusion criterion due to the minimally invasive nature of the procedure. Patients excluded after enrollment were those who were unable to communicate independently by telephone (whether due to mental status, disability, or language barrier), pregnant, discharged to a skilled nursing or rehabilitation facility, experienced a procedure complication, readmitted to the hospital, remained in the hospital four or more days after surgery, refused to participate, or could not be reached. Our aim was to collect data from at least 10 patients per procedure in order for any findings to be considered clinically relevant.

Between July 2016 and February 2017, 844 patients were screened into the study. Of these, 305 met one or more exclusion criterion and 539 patients remained eligible for the telephone questionnaire.

Measurements

Morphine milligram equivalents (MME) for each opioid prescription (including tramadol) were calculated using the conversion formulae recommended by the Centers for Disease Control (22) and the Washington State Agency Medical Directors' Group guidelines (23). During data collection we noted that tramadol was occasionally prescribed in addition to another opioid, and we attempted to clarify when this occurred in our findings.

Retrospective review of prescription data—For each patient discharged after a surgical procedure, we extracted the following data from the electronic medical record: procedure name and CPT code, attending name and specialty, prescription date, medication name, strength, and quantity for all Schedule II–IV opioids and tramadol, as well as the name and type of prescriber (attending, resident, or advanced practice provider – henceforth referred to as APP – which included advanced practice nurse practitioners and physician assistants). We analyzed data from 10,112 patients who underwent 11,566 procedures between July 1, 2015 and June 30, 2016.

Prospective telephone questionnaire and chart review data—We collected demographic data and details of the patient's surgery, recovery period, and opioid prescription history, in addition to their questionnaire data. Our primary outcome measures were the quantity and proportion of opioid prescribed and used after surgery, and the proportion of patients who received instructions on medication disposal and non-opioid pain management strategies.

Data Analysis

Retrospective review of prescription data—We used descriptive statistics to summarize characteristics associated with common procedures in general and orthopaedic surgery, urology and gynecology, including the number of procedures performed annually, inpatient versus outpatient, length of stay, category of opioid prescribed at discharge (if any), total MME prescribed, and the role of the prescriber (attending, resident, or APP).

Prospective telephone questionnaire and chart review data—We tabulated the frequency of specific surgical procedures according to surgical specialty. We characterized distributions of MME prescribed, MME used, and proportion of MME used with univariate statistics (medians, quartiles, and ranges). We also calculated the relative frequencies of responses regarding opioid use, non-opioid pain management, and medication disposal. Finally, we constructed violin plots to visualize smoothed, empirical distributions of the MMEs prescribed and used for specific surgical procedures. Violin shapes are mirrored kernel densities of the distribution of values (24).

All analyses were performed using Stata (StataCorp), version 14 (25).

Results

Retrospective review of prescription data

Of the 10,112 patients identified, 57% were female and the median patient age was 56. Outpatient procedures constituted 65% of all procedures and 76% of patients were discharged with a prescription for either an opioid or tramadol. In this academic setting, most of the prescriptions for opioids were written by residents (63%) or APPs (24%) (Table 1). The most commonly prescribed opioid medications were oxycodone (44%) and hydromorphone (31%). Median prescription sizes for each category of opioid, described in number of pills and MME per prescription, are provided in Table 2.

To understand the relative contribution of each surgical specialty to potentially divertible medication we also calculated the annual volume of opioids prescribed by specialty: orthopaedic surgery (1,518,097 MME per year), general surgery (580,983 MME per year), gynecology (218,282 MME per year), and urology (143,552 MME per year).

Table 3 summarizes the opioid prescribing patterns after common surgical procedures for each of the four surgical specialties. For certain procedures (e.g. partial mastectomy), many patients were not prescribed any opioid medication, which is reflected in the first (Q1) and third (Q3) quartiles that are listed as 0 MME. The highest rates of tramadol prescribing

occurred after hip (78%) and knee arthroplasty (65%), and lumbar arthrodesis (61%), with a typical prescription being 50 tablets of 50 mg tramadol (50 MME).

Prospective telephone questionnaire and chart review data

Of the 539 patients who were eligible for the telephone questionnaire, 180 were either not contacted, unable to communicate by telephone, or declined to participate. Data were successfully collected on 359 (67% participation rate). Table 4 highlights certain characteristics of these patients who were eligible and agreed to participate in the study.

Of the patients in our final sample of 359, 53% were male and the median age was 58. We found that 84% (n=300) of patients reported receiving instructions on non-opioid pain management including acetaminophen or non-steroidal anti-inflammatory drug (NSAID) use, heat or cold therapy, or exercise. Most patients (92%, n=330) reported receiving an opioid after their surgery. In contrast, 34% of all patients (n=122) did not receive, did not fill, or did not use an opioid prescription.

For those patients who were prescribed an opioid (n=330), the most commonly prescribed medications were hydromorphone (47%, n=148) and oxycodone (41%, n=128). Combination hydrocodone/acetaminophen made up 9% of prescriptions (n=27). Tramadol was prescribed along with a more potent opioid medication in 17% of patients (n=55) and prescribed alone in 3% (n=8). Only 18% of patients (n=44) recalled receiving instructions on safe opioid disposal.

To better understand the true distribution of opioid prescribing and use across all patients, we included patients who did not receive an opioid prescription after surgery and extrapolated their opioid use to be 0 MME when running our analyses. We found that 332 patients (including those who did not receive an opioid prescription) had the necessary data to calculate MME prescribed, MME used, and proportion of opioid used by procedure (Table 5). Across all patients and procedures, the median prescription size was 120 MME with a range of 0 to 648 MME. The median proportion of opioid used was 27% of the prescribed amount, or 24 MME. We found that 75% of patients used 80% or less of the amount prescribed, or 96 MME. The MME used across all patients and procedures ranged from 0 to 528.

A side by side comparison of the MME prescribed and MME used for each procedure is illustrated in a violin plot in Figure 1.

Discussion

A unique feature of our study is the prospective collection of data on both opioid prescribing and use across multiple surgical specialties in the immediate post-operative period. We found a wide range in the amount of opioid prescribed after common surgical procedures (median prescription size 120 MME, range 0 to 648 MME), which is consistent with prior studies (13–15). This variability is likely influenced by a number of factors, including patient education, surgeon-specific practices, and certain patient-specific differences in post-operative pain. Furthermore, our procedure groupings (e.g. “endoscopy” for urology and

"shoulder arthroscopy/repair" for orthopaedic surgery) each included a range of procedures with varying degrees of expected postoperative pain, which may also have contributed to opioid prescription variability.

Our data demonstrated that the median amount of opioid used by patients was only 27% of the prescribed amount, which further highlights a concerning pattern of over-prescribing across multiple surgical specialties seen elsewhere in the literature (15–20). With 73% of medication remaining unused and at risk for diversion or misuse in the community, our finding that 82% of patients did not recall being instructed in the safe disposal of unused opioid medication has prompted the development of more uniform discharge instructions at our institution, including links within the electronic medical record to the Vermont Department of Health and medication disposal resources. Interestingly, over one-third of all patients we contacted did not receive, fill, or use an opioid prescription after their procedure. Similar findings have been noted in other studies (15, 18) and serve as a reminder that opioid pain management is not always necessary, even after major procedures such as joint arthroplasty.

Many state legislatures and health departments are adopting stricter rules governing opioid prescription practices, risk assessment of patients, and prescription drug monitoring programs (26). As of July 1, 2017, there are new requirements in the state of Vermont for providers prescribing opioids for acute and chronic pain (27). These include checking the Vermont Prescription Monitoring System (VPMS) for first-time opioid prescriptions greater than 10 pills, documenting patient informed consent for opioid use, and MME limits on certain opioid prescriptions according to the severity of the condition being treated or type of procedure performed.

Because of this trend, it will be increasingly incumbent on all prescribers to be familiar with MME dosing. Also unique to our study is the conversion of all opioid quantities into MME, which facilitates a more direct comparison across opioid type and prescription strength. We expect our findings, as well as those at other institutions, will be a useful reference as prescribing standards evolve. It will also be important for surgeons to engage with health departments and legislators in this process, in order to facilitate safe and effective prescribing, and minimize the unintended consequence of under treating post-operative pain.

In some cases, we found that the amount of medication use by patients was significantly more or less than expected. For example, the median opioid used by partial mastectomy, carpal tunnel and vasectomy patients was 0 MME (maximum 10–80 MME), while the median amount prescribed was a high as 40–60 MME, or the equivalent of 4–8 pills of 2 mg hydromorphone. These data would suggest that pre-operative discussions with patients about their pain tolerance, risk of opioid abuse, willingness to take opioids, or alternative methods of pain control could lead to fewer unused prescriptions. Our institutional opioid informed consent form, which complies with the 2017 Vermont Department of Health Rule, reviews these topics and facilitates such a discussion with patients.

In contrast, our data on hip and knee arthroplasty demonstrated that the median proportion used ranged from 31–50%. There was a much wider range of opioid use in these procedures

(0–528 MME and 0–480 MME, respectively), including those patients who used no opioid at all. We suspect that pre-operative pain, and perhaps prior use of opioids, may have influenced post-operative usage. Identifying the factors that influence post-operative opioid use was beyond the scope of this study, however other studies have suggested patient age, insurance type, non-opioid adjunct therapy and prior opioid use to be contributing factors (17, 20).

We also noted that in both datasets the concurrent prescribing of tramadol in addition to a more potent opioid was taking place more often than anticipated, the majority of this practice occurring after orthopaedic surgeries. As this practice was an unexpected finding, our prospective questionnaire was designed to capture only the amount of the most potent opioid used, thus limiting our ability to assess whether concurrent tramadol use influenced the amount of opioid used.

While our findings reinforce the general perception that excess opioids are being prescribed after surgery, they also reflect the experience of a single academic medical center and are likely influenced by institution-specific factors. They also reflect practices and medication use specific to the specialties and procedures included in the study. While this may limit generalizability to some extent, the similarity of our findings to other recent studies in the literature suggests they may be more broadly applicable.

An inherent limitation of telephone questionnaire data is the reliance on patient recall and the inability to confirm the number of pills that patients reported using. This was felt to be acceptable given the effort it would have required to coordinate in-person interviews within the immediate post-operative timeframe. Our contact window was intended to occur at a time when patients were no longer requiring opioid medication and could still recall their pain management regimen and the amount of medication they used. The number of pills a patient was prescribed after surgery was confirmed by chart review in most cases.

Finally, it is possible that our exclusion criteria, especially regarding hospital length of stay and malignancy, were excessively stringent, thus limiting our sample size and the analyses that could be performed, including the detection of differences in opioid use in patients taking an opioid prior to surgery or receiving non-opioid pain management instructions.

Ultimately the question remains, how much should we be prescribing after surgery? There are some procedures for which the use of non-opioid pain management strategies should suffice with the addition of an opioid prescription on a case-by-case basis. This approach has been advocated for in the oral surgery literature for their most common procedure, extraction of wisdom teeth (28). Using data like ours, percentiles of MMEs prescribed and used among all patients who undergo specific procedures could be used to guide prescribing in subsequent patients undergoing the same procedures. If we set a policy of prescribing at the median level of use reported, then half of all patients would have adequate coverage of their pain, while half would require a refill. Alternatively, targeting prescriptions for the 75th percentile of opioid use for each procedure would result in a 20% reduction in prescription size across all procedures, while ensuring that the vast majority of patients achieve sufficient pain control with a single opioid prescription.

It has been shown that procedure-specific recommendations for opioid prescribing at discharge reduces the amount of opioid medication prescribed (29, 30). Our institution has developed a built-in decision support tool in the electronic medical record system to guide prescribers to the recommended MME to prescribe for certain common surgical procedures in conjunction with prescribing requirements outlined in the 2017 Vermont Department of Health Rule. This tool incorporates the patient usage data described here into a table grouping common surgical procedures to different pain categories and indicating the appropriate dosing and frequency of commonly prescribed opioid medications for mild, moderate, and severe pain. The goals of this effort are to minimize the quantity of excess opioids prescribed and familiarize prescribers with the concept of prescribing based on MME, particularly the residents and APPs who are doing the majority of opioid prescribing.

Conclusions

Our study shows that opioids are frequently being prescribed in excess after common surgical procedures and patients are not adequately instructed on how to dispose of unused medication. It also highlights considerable variability in the quantity of opioids prescribed and used after common procedures. Further investigation into the factors that influence opioid use after surgery is indicated.

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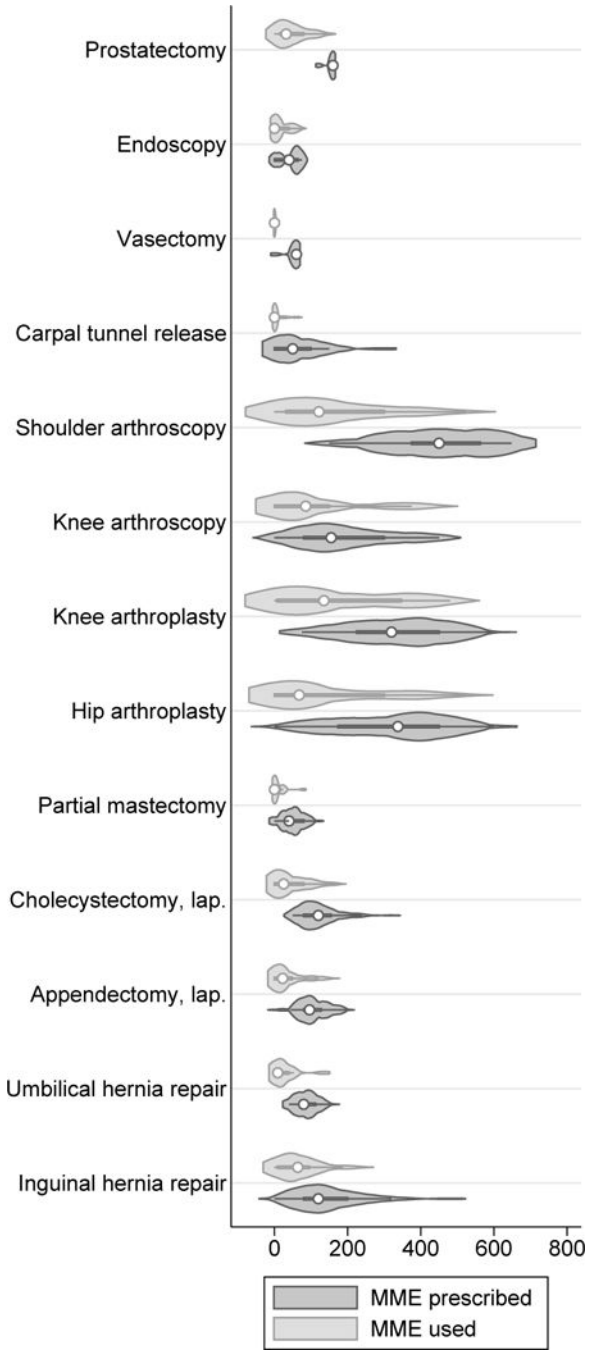

Figure 1.

Violin plot of morphine milligram equivalents (MME) prescribed and used after common surgical procedures—2016–2017 (prospective dataset). Interior markings represent the median (white dot), interquartile range (thick line), and the adjacent values (thin line, i.e. the typical whiskers on a box plot). Lap, laparoscopic.

Table 1

Characteristics of Patients, Procedures, and Prescriptions: A 2015–2016 Retrospective Dataset of Electronic Medical Record Data

Characteristic	Data
Patient, (N=10,112)	
Age, y, median (Q1–Q3)	56 (42–67)
Sex, female, n (%)	5,757 (57)
Insurance type, n (%)	
Commercial	5,014 (50)
Medicare	3,134 (31)
Medicaid	1,150 (11)
Other	814 (8)
Procedure, (N=11,566), n (%)	
Specialty	
Orthopaedic surgery	5,100 (44)
General surgery	3,153 (27)
Gynecology	1,680 (15)
Urology	1,633 (14)
Outpatient procedure	7,471 (65)
Prescription combinations per procedure	
No opioid or tramadol	2,785 (24)
Opioid only	7,463 (65)
Tramadol only	369 (3)
Opioid and tramadol	949 (8)
Prescription, (N=10,402), n (%)	
Prescriber role	
Resident	6,581 (63)
Advanced practice provider	2,464 (24)
Attending	1,357 (13)

Q1, 1st quartile; Q3, 3rd quartile.

Table 2

Characteristics of Medication Prescribed: A 2015–2016 Retrospective Dataset of Electronic Medical Record Data

Medication prescribed, (N=10,402)	n	%	Number of pills/Rx, median	MME/Rx, median
Oxycodone	4,630	44	30	225
Hydromorphone	3,204	31	25	200
Tramadol	1,318	13	50	250
Hydrocodone	805	8	20	100
Other opioid	445	4	–	–

MME, morphine milligram equivalents; Rx, prescription.

Table 3

Prescriptions at Discharge after Selected Surgical Procedures: A 2015–2016 Retrospective Dataset of Electronic Medical Record Data

Surgical procedure	Procedure frequency*, n	Opioid prescription rate†, %	Tramadol prescription rate†, %	MME prescribed‡, median (Q1–Q3)
General surgery				
Appendectomy (lap)	156	87	3	160 (120–240)
Cholecystectomy (lap)	331	90	3	160 (120–240)
Colectomy, partial (lap or open)	179	80	5	225 (113–300)
Hernia (inguinal, ventral, incisional)	445	90	3	160 (96–225)
Mastectomy, partial	198	74	1	96 (0–160)
Gynecology				
Hysterectomy (lap or vaginal)	217	98	<1	240 (225–300)
Hysterectomy (open)	65	98	0	300 (240–320)
Hysteroscopy	246	23	0	0 (0–0)
Urethral sling procedure	94	82	0	75 (40–113)
Orthopaedic surgery				
Carpal tunnel release	320	65	5	75 (0–119)
Hip arthroplasty	320	84	78	300 (150–480)
Knee arthroplasty	341	79	65	300 (113–480)
Knee arthroscopy	273	92	5	225 (150–240)
Lumbar arthrodesis	101	79	61	375 (113–630)
Rotator cuff repair (arthroscopic)	52	90	0	503 (450–600)
Trigger finger release	103	42	3	0 (0–75)
Urology				
Cystoscopy (± stent, biopsy, tumor fulguration or resection)	633	60	1	64 (0–113)
Prostatectomy (lap)	88	97	2	160 (160–160)
Transurethral resection or laser vaporization of prostate	80	65	0	75 (0–113)

*Average number of procedures performed per year

†Proportion of annual procedures that received an opioid or tramadol prescription

‡For non-tramadol opioid prescriptions

Lap, laparoscopic; MME, morphine milligram equivalents; Q1, 1st quartile; Q3, 3rd quartile.

Table 4

Characteristics of Eligible Participants for Evaluation of Opioid Prescribing and Use: Data from a 2016–2017 Prospective Dataset Questionnaire and Chart Review

Characteristic	Data
All patients, n	359
Age, y, median (Q1–Q3)	58 (44–68)
Sex, n (%)	
Female	170 (47)
Male	189 (53)
Procedure, n (%)	
General surgery	
Mastectomy, partial	24 (7)
Appendectomy (lap)	18 (5)
Umbilical hernia repair (open)	19 (5)
Inguinal hernia repair (open)	26 (7)
Cholecystectomy (lap)	40 (11)
Orthopaedic surgery	
Carpal tunnel release	28 (8)
Knee arthroscopy/repair	32 (9)
Shoulder arthroscopy/repair	25 (7)
Knee arthroplasty	32 (9)
Hip arthroplasty	44 (12)
Urology	
Vasectomy	12 (3)
Endoscopy	42 (12)
RALP	17 (5)

Lap, laparoscopic; Q1, 1st quartile; Q3, 3rd quartile; RALP, robotic-assisted laparoscopic prostatectomy.

Table 5

Quantity of Opioid Prescribed and Used after Common Surgical Procedures: Data from a 2016–2017 Prospective Dataset Questionnaire and Chart Review

Surgical procedure		MME prescribed*				MME used				Proportion used, %	
	n	Q1	Median	Q3	Range	Q1	Median	Q3	Range	Median	Q3
All patients	332	75	120	300	(0–648)	0	24	96	(0–528)	27	80
General surgery											
Mastectomy, partial	21	40	40	80	(0–120)	0	0	16	(0–80)	0	40
Umbilical hernia repair (open)	16	68	80	113	(40–160)		9	39	(0–136)	20	70
Appendectomy (lap)	17	80	96	128	(0–200)	0	23	48	(0–160)	18	71
Cholecystectomy (lap)	40	80	120	155	(50–320)	0	25	80	(0–173)	20	68
Inguinal hernia repair (open)	25	80	120	200	(0–480)	8	64	96	(0–240)	50	100
Orthopaedic surgery											
Carpal tunnel release	28	0	50	100	(0–300)	0	0	15	(0–70)	7	60
Knee arthroscopy/repair	30	80	155	300	(0–450)	0	86	150	(0–450)	50	100
Shoulder arthroscopy/repair	23	375	450	563	(150–648)	32	122	300	(0–525)	25	65
Hip arthroplasty	45	174	338	450	(0–600)	0	68	300	(0–528)	31	90
Knee arthroplasty	31	225	320	450	(75–600)	8	135	347	(0–480)	50	100
Urology											
Vasectomy	11	60	60	60	(0–60)	0	0	0	(0–10)	0	0
Endoscopy	29	0	40	64	(0–75)	0	0	40	(0–75)	75	100
RALP	17	160	160	160	(120–160)	16	32	80	(0–144)	20	50

*Includes patients who were not prescribed an opioid after their procedure.

Lap, laparoscopic; MME, morphine milligram equivalents; Q1, 1st quartile; Q3, 3rd quartile; RALP, robotic-assisted laparoscopic prostatectomy.