The American Journal of Surgery 221 (2021) 455–459

Contents lists available at ScienceDirect

The American Journal of Surgery

journal homepage: www.americanjournalofsurgery.com

Impact of opioid prescribing guidelines on prescribing at discharge from endocrine surgery

Alaa Sada [a, b], Amy E. Glasgow [b, c], Benzon M. Dy [a], Melanie L. Lyden [a], Geoffrey B. Thompson [a], Travis J. McKenzie [a], Elizabeth B. Habermann [b, c, *]

[a] Department of Surgery, Mayo Clinic, 200th 1st Street, Rochester MN, 55905, USA
[b] Department of Health Services Research, Mayo Clinic, 200th 1st Street, Rochester MN, 55905, USA
[c] Mayo Clinic Robert D and Patricia E Kern Center for the Science of Health Care Delivery, 200th 1st Street, Rochester MN, 55905, USA

ARTICLE INFO

Article history:
Received 24 April 2020
Received in revised form
19 June 2020
Accepted 6 August 2020

Keywords:
Opioid
Endocrine surgery
Thyroidectomy
Parathyroidectomy
Adrenalectomy

ABSTRACT

Introduction: In 2018, our institution implemented opioid prescribing guidelines for endocrine surgery.
Methods: We evaluated prescribing trends before and after the guidelines (60 MME following adrenal procedures and 37.5 MME for thyroid/parathyroid procedures) using chi-squared and Wilcoxon Rank-Sum tests.
Results: We identified 357 patients in the pre-guideline and 397 in the post-guideline period. The proportion discharged with any opioid prescription decreased from 96.1% to 77.3%, $p < 0.01$, and the median (IQR) prescribed amount decreased from 150.0 (100.0, 200.0) to 50.0 (25.0, 75.0), $p < 0.01$ overall and within each category. The proportion receiving prescription above the upper guidelines limit also decreased, while opioid refills within 30-day of discharge remained stable (2.8% before and 4.5% after the guidelines, $p = 0.21$).
Conclusion: Opioid prescribing guidelines for endocrine surgical procedures decreased both the proportion of patients receiving opioids and the amount when prescribed, therefore further supporting the utility of opioid prescribing guidelines in decreasing over-prescription.

Introduction

In the 1990s, studies claimed that opioid addiction was rare in medical patients and should not be an obstacle toward prescribing opioids in patients undergoing surgery.[1–3] As a result, opioids prescribing peaked between the 1990s and 2012 and resulted in the current opioid epidemic that is considered a public health emergency.[2]

As the United States began to realize the magnitude of the prescription opioid crisis, several institutional, state and federal initiatives have been working toward containing this epidemic by limiting over-prescribing and reducing the amount of unused opioids at risk of diversion. Not surprisingly, several prescribing guidelines have been developed and implemented on institutional, federal and national levels.

A large quality improvement initiative was conducted in our institution to limit opioid over-prescription at discharge among surgical patients without compromising their postoperative pain management.[4] This resulted in developing and implementing new prescribing guidelines covering different surgical procedures and specialties in the Department of Surgery at Mayo Clinic in Rochester, MN. Endocrine surgery adopted these prescribing guidelines in February 2018, which recommended prescribing 60 morphine milligram equivalent (MME) for patients undergoing minimally invasive adrenalectomy and 37.5 MME for patients undergoing thyroid/parathyroid procedures.[5] Whether these guidelines have altered our prescribing patterns, specifically for endocrine surgery procedures, remains unknown. Therefore, we conducted this study to compare opioid prescribing trends before and after the guidelines era to better understand the impact and outcomes of implementing these guidelines in our endocrine surgery practice.

Methods

Following Mayo Clinic's Institutional Review Board approval, a retrospective institutional study evaluated opioid prescribing

* Corresponding author. Mayo Clinic, Surgical Outcomes Program, Robert D and Patricia E Kern Center for The Science of Health Care Delivery, Rochester, MN, USA.
E-mail address: Habermann.elizabeth@mayo.edu (E.B. Habermann).

https://doi.org/10.1016/j.amjsurg.2020.08.004
0002-9610/

trends for patients undergoing endocrine surgery procedures before (July–December 2016) and after (July–December 2018) implementation of general surgery opioid prescribing guidelines in February 2018. To account for patients' variability in opioid requirement, three dosing options were developed per procedure: low, standard and high opioid dosing as shown in Table 1.[4] Details about sorting patients into each dosing strata are outlined in our previous work.[4] Clinical judgment continues to be the most important consideration for opioid dosing including anticipated intensity of pain associated with the patient's condition, the extent of non-opioid analgesics utilized and pain scores reported by the patient before discharge, while limiting the consideration for high opioid dosing to pre-operative opioid users.[4]

The standard dosing option suggested prescribing 37.5 MME (5 tabs of 5 mg oxycodone) for thyroid/parathyroid procedures while limiting the maximum amount to 75 MME (10 tabs), and 60 MME (8 tabs of 5 mg oxycodone) for minimally invasive adrenalectomy with a maximum amount of 150 MME (20 tabs) at the time of discharge (Table 1). Prescriptions above the guidelines were defined as opioids amount exceeding the high dosing group recommendations.

Thyroid/parathyroid and minimally invasive adrenalectomy procedures performed by our endocrine surgeons on adult patients were included: first time or redo parathyroidectomy with unilateral or bilateral cervical exploration, total or partial thyroidectomy with/without radical neck dissection or limited neck dissection, thyroidectomy including substernal thyroid removal through cervical approach, and total or partial laparoscopic/robotic adrenalectomy including transabdominal and retroperitoneal approaches. Surgeries were identified from administrative billing data with current procedural terminology codes (CPT) for the procedures. Medical records were abstracted to search for prescriptions written or documented as indicated by the patient on intake between 90 days before surgery and up to 30 days after discharge.

Patients were defined as having a history of opioid use if documentation was found in the 90 days before surgery (up to 7 days before surgery). Patients with no prescriptions documented (either by prescription or documented as historical user) in this time period were considered opioid naïve. Prescriptions written during the 7 days preoperatively and during the hospital stay were not counted as some surgeries require prescriptions before surgery.

Discharge opioid prescriptions were abstracted from the medical records and converted to Morphine Milligram Equivalents (MME). Refills were defined as any opioid prescription written within our system from 1 to 30 days after discharge. Univariate analysis comparing pre and post-guidelines opioid prescriptions was conducted using Chi-squared and Wilcoxon Rank-Sum tests. Analysis was performed using SAS version 9.4 (SAS Institute Inc., Cary, NC). All p-values were considered statistically significant at $p < 0.05$.

Results

A total of 357 patients underwent endocrine surgery in the pre-guideline period (150 thyroid, 144 parathyroid and 63 adrenal), and 397 underwent resection in the post-guideline period (204 thyroid, 135 parathyroid and 58 adrenal). There was no difference in the proportion of preoperative opioid users and opioid naïve patients undergoing surgery before and after guideline implementation ($p > 0.05$).

The proportion of endocrine surgery patients discharged with any opioid prescription decreased from 96.1% to 77.3%, ($p < 0.01$) overall and within each procedure category: from 95.3% to 77.0% ($p < 0.01$) for thyroid, from 95.1% to 71.1%, ($p < 0.01$) for parathyroid, and from 100.0% to 93.1% ($p = 0.03$) for adrenal procedures as shown in Tables 2–5.

The median (IQR) prescribed MME decreased from 150.0 (100.0,200.0) to 50.0 (25.0,75.0), $p < 0.01$ overall and within each procedure category: from 150.0 (100.0,200.0) to 50.0 (25.0,60.0) MME for thyroid, from 112.5 (100.0,150.0) to 50.0 (0.0,60.0) for parathyroid, and from 225 (187.5360.0) to 75 (60.0, 112.5) for adrenal procedures, all $p < 0.01$. The proportion of patients prescribed >200 MME has decreased overall from 24.1% to 2.3%, ($p < 0.01$) as well as within each procedure category as shown in Tables 2–5

The proportion of patients receiving opioid prescription above the upper limit of guidelines overall has decreased from 86.0% to 11.8%, $p < 0.01$ after the guidelines and within each category as shown in Tables 2–5 In the meantime, the proportion of patients in the low opioids dosing group has increased overall from 3.9% to 22.7%, as well as for each procedure category after implementing the guidelines, all $p < 0.01$. Tables 2–5

Opioid refills within 30 days of discharge remained stable overall (2.8% before and 4.5% after the guidelines, $p = 0.21$) and

Table 2
Opioid prescription trends among endocrine surgery patients.

	Pre-guidelines	Post-guidelines	P-value
	N = 357	N = 397	
Previous opioid use			0.69
Opioid Naive	303 (84.9%)	341 (85.9%)	
Opioid Tolerant	54 (15.1%)	56 (14.1%)	
Any opioid prescription			<0.01
No	14 (3.9%)	90 (22.7%)	
Yes	343 (96.1%)	307 (77.3%)	
Opioid prescribed (MME)			<0.01
Median	150	50	
Q1, Q3	100.0, 200.0	25.0, 75.0	
Range	(0.0–1000.0)	(0.0–525.0)	
Prescribed MME>200			<0.01
No	271 (75.9%)	388 (97.7%)	
Yes	86 (24.1%)	9 (2.3%)	
Opioid refill			0.21
No	347 (97.2%)	379 (95.5%)	
Yes	10 (2.8%)	18 (4.5%)	
Prescribing guidelines group			<0.01
Low	14 (3.9%)	90 (22.7%)	
Medium	0 (0.0%)	77 (19.4%)	
High	36 (10.1%)	183 (46.1%)	
Above High	307 (86.0%)	47 (11.8%)	
Prescribed > guidelines			<0.01
No	50 (14.0%)	350 (88.2%)	
Yes	307 (86.0%)	47 (11.8%)	

Table 1
Endocrine surgery opioid prescription guidelines (adult).

Procedure	Low opioid dosing	Standard opioid dosing	High opioid dosing
Thyroid/parathyroid surgery	NSAIDs/Acetaminophen only	5 tabs oxycodone (5 mg) **or** 10 tabs tramadol (50 mg)	10 tabs oxycodone (5 mg) **or** 15 tabs tramadol (50 mg)
MIS* adrenalectomy	NSAIDs/Acetaminophen only	8 tabs oxycodone (5 mg) **or** 12 tabs tramadol (50 mg)	20 tabs oxycodone (5 mg) **or** 30 tabs tramadol (50 mg)

MIS*: minimally invasive surgery including robotic and laparoscopic approach.

Table 3
Opioid prescription trends among thyroid surgery patients.

	Pre-guidelines	Post-guidelines	P-value
	N = 150	N = 204	
Previous opioid use			0.08
Opioid Naive	127 (84.7%)	185 (90.7%)	
Opioid Tolerant	23 (15.3%)	19 (9.3%)	
Any opioid prescription			<0.01
No	7 (4.7%)	47 (23.0%)	
Yes	143 (95.3%)	157 (77.0%)	
Opioid prescribed (MME)			<0.01
Median	150	50	
Q1, Q3	100.0, 200.0	25.0, 60.0	
Range	(0.0–475.0)	(0.0–525.0)	
Prescribed MME>200			<0.01
No	120 (80.0%)	200 (98.0%)	
Yes	30 (20.0%)	4 (2.0%)	
Opioid refill			0.68
No	146 (97.3%)	197 (96.6%)	
Yes	4 (2.7%)	7 (3.4%)	
Prescribing guidelines group			<0.01
Low	7 (4.7%)	47 (23.0%)	
Medium	0 (0.0%)	43 (21.1%)	
High	9 (6.0%)	86 (42.2%)	
Above High	134 (89.3%)	28 (13.7%)	
Prescribed > guidelines			<0.01
No	16 (10.7%)	176 (86.3%)	
Yes	134 (89.3%)	28 (13.7%)	

Table 5
Opioid prescription trends among adrenal surgery patients.

	Pre-guidelines	Post-guidelines	P-value
	N = 63	N = 58	
Previous opioid use			0.83
Opioid Naive	53 (84.1%)	48 (82.8%)	
Opioid Tolerant	10 (15.9%)	10 (17.2%)	
Any opioid prescription			0.03
No	0 (0.0%)	4 (6.9%)	
Yes	63 (100.0%)	54 (93.1%)	
Opioid prescribed (MME)			<0.01
Median	225	75	
Q1, Q3	187.5, 360.0	60.0, 112.5	
Range	(100.0–1000.0)	(0.0–450.0)	
Prescribed MME>200			<0.01
No	19 (30.2%)	53 (91.4%)	
Yes	44 (69.8%)	5 (8.6%)	
Opioid refill			0.63
No	59 (93.7%)	53 (91.4%)	
Yes	4 (6.3%)	5 (8.6%)	
Prescribing guidelines group			<0.01
Low	0 (0.0%)	4 (6.9%)	
Medium	0 (0.0%)	13 (22.4%)	
High	14 (22.2%)	35 (60.3%)	
Above High	49 (77.8%)	6 (10.3%)	
Prescribed > guidelines			<0.01
No	14 (22.2%)	52 (89.7%)	
Yes	49 (77.8%)	6 (10.3%)	

within each procedure. Tables 2–5

While the previous results represent our entire cohort, similar findings were observed when evaluating opioid prescribing trends among opioid naïve patients. The proportion of opioid naïve patients provided any opioid prescription at discharge has decreased after implementing the guidelines from 96.7% to 77.4% ($p < 0.01$) overall, from 96.1% to 76.8% ($p < 0.01$) for thyroid surgery patients, from 95.9% to 72.2% ($p > 0.01$) for parathyroid patients, and from 100.0% to 91.7 ($p = 0.03$) for adrenal patients. Tables 6–9. Similarly to the above, the amount prescribed decreased after implementing the guidelines without increasing the rate of opioid refill as shown in Tables 6–9

Table 4
Opioid prescription trends among parathyroid surgery patients.

	Pre-guidelines	Post-guidelines	P-value
	N = 144	N = 135	
Previous opioid use			0.23
Opioid Naive	123 (85.4%)	108 (80.0%)	
Opioid Tolerant	21 (14.6%)	27 (20.0%)	
Any opioid prescription			<0.01
No	7 (4.9%)	39 (28.9%)	
Yes	137 (95.1%)	96 (71.1%)	
Opioid prescribed (MME)			<0.01
Median	112.5	50	
Q1, Q3	100.0, 150.0	0.0, 60.0	
Range	(0.0–375.0)	(0.0–180.0)	
Prescribed MME>200			<0.01
No	132 (91.7%)	135 (100.0%)	
Yes	12 (8.3%)	0 (0.0%)	
Opioid refill			0.12
No	142 (98.6%)	129 (95.6%)	
Yes	2 (1.4%)	6 (4.4%)	
Prescribing guidelines group			<0.01
Low	7 (4.9%)	39 (28.9%)	
Medium	0 (0.0%)	21 (15.6%)	
High	13 (9.0%)	62 (45.9%)	
Above High	124 (86.1%)	13 (9.6%)	
Prescribed > guidelines			<0.01
No	20 (13.9%)	122 (90.4%)	
Yes	124 (86.1%)	13 (9.6%)	

Discussion

Implementing opioid prescribing guidelines in our endocrine surgery practice succeeded in decreasing the proportion of patients receiving opioids as well as the variability and amount of opioids when provided at discharge. Moreover, we were able to maintain low and stable refill rates, despite the significant reduction in prescribed opioids. These findings highlight the significance of adopting opioid prescribing guidelines that are tailored toward different procedures in addressing over-prescription of opioids.

It is well known that prescribing opioids for surgical patients was subject to wide variation, which predisposed significant proportions of over-prescribed opioid pills to be at risk of diversion and misuse.[3] In an effort to optimize opioid prescribing practices for

Table 6
Opioid prescription trends among opioid naïve patients.

	Pre-guidelines	Post-guidelines	P-value
	N = 303	N = 341	
Any opioid prescription			<0.01
No	10 (3.3%)	77 (22.6%)	
Yes	293 (96.7%)	264 (77.4%)	
Opioid prescribed (MME)			<0.01
Median	150	50	
Q1, Q3	100.0, 200.0	25.0, 75.0	
Range	(0.0–950.0)	(0.0–324.0)	
Prescribed MME>200			<0.01
No	233 (76.9%)	337 (98.8%)	
Yes	70 (23.1%)	4 (1.2%)	
Opioid refill			0.40
No	295 (97.4%)	328 (96.2%)	
Yes	8 (2.6%)	13 (3.8%)	
Prescribing guidelines group			<0.01
Low	10 (3.3%)	77 (22.6%)	
Medium	0 (0.0%)	68 (19.9%)	
High	32 (10.6%)	160 (46.9%)	
Above High	261 (86.1%)	36 (10.6%)	
Prescribed > guidelines			<0.01
No	42 (13.9%)	305 (89.4%)	
Yes	261 (86.1%)	36 (10.6%)	

Table 7
Opioid prescription trends among opioid naïve thyroid patients.

	Pre-guidelines	Post-guidelines	P-value
	N = 127	N = 185	
Any opioid prescription			<0.01
No	5 (3.9%)	43 (23.2%)	
Yes	122 (96.1%)	142 (76.8%)	
Opioid prescribed (MME)			<0.01
Median	150	50	
Q1, Q3	100.0, 200.0	25.0, 60.0	
Range	(0.0–475.0)	(0.0–300.0)	
Prescribed MME>200			<0.01
No	100 (78.7%)	183 (98.9%)	
Yes	27 (21.3%)	2 (1.1%)	
Opioid refill			0.96
No	123 (96.9%)	179 (96.8%)	
Yes	4 (3.1%)	6 (3.2%)	
Prescribing guidelines group			<0.01
Low	5 (3.9%)	43 (23.2%)	
Medium	0 (0.0%)	40 (21.6%)	
High	8 (6.3%)	78 (42.2%)	
Above High	114 (89.8%)	24 (13.0%)	
Prescribed > guidelines			<0.01
No	13 (10.2%)	161 (87.0%)	
Yes	114 (89.8%)	24 (13.0%)	

Table 9
Opioid prescription trends among opioid naïve adrenal patients.

	Pre-guidelines	Post-guidelines	P-value
	N = 53	N = 48	
Any opioid prescription			0.03
No	0 (0.0%)	4 (8.3%)	
Yes	53 (100.0%)	44 (91.7%)	
Opioid prescribed (MME)			<0.01
Median	225	75	
Q1, Q3	175.0, 300.0	60.0, 112.5	
Range	(100.0–950.0)	(0.0–324.0)	
Prescribed MME>200			<0.01
No	18 (34.0%)	46 (95.8%)	
Yes	35 (66.0%)	2 (4.2%)	
Opioid refill			0.90
No	50 (94.3%)	45 (93.8%)	
Yes	3 (5.7%)	3 (6.3%)	
Prescribing guidelines group			<0.01
Low	0 (0.0%)	4 (8.3%)	
Medium	0 (0.0%)	10 (20.8%)	
High	13 (24.5%)	32 (66.7%)	
Above High	40 (75.5%)	2 (4.2%)	
Prescribed > guidelines			<0.01
No	13 (24.5%)	46 (95.8%)	
Yes	40 (75.5%)	2 (4.2%)	

surgical patients, while taking into consideration different patient and procedure factors, we conducted a large initiative that resulted in implementing opioid prescribing guidelines in our institution.[4–6] These guidelines were developed based on surveying patients and taking into account their actual opioid consumption and pain management experience rather than assuming their need.[4] Following strict guidelines implementation that involved multidisciplinary teams and leaderships, we decided to further assess the impact of these guidelines among our endocrine surgery practice that includes wide variety of thyroid, parathyroid and adrenal procedures.

Our study showed significant decrease in the proportion of patients receiving any opioid prescription at discharge as well as in the amount prescribed. In the meantime, the proportion of patients receiving pain medications based on the low dosing recommendation (over the counter acetaminophen and/or NSAIDS) has increased in the post-guidelines era.[5] Interestingly, these findings were more prominent for patients undergoing thyroid and parathyroid surgery compared to patients undergoing adrenal surgery. This can be explained by the fact that our guidelines recommended higher opioid doses for MIS adrenalectomy compared to thyroid and parathyroid procedures, as the proportion of patients prescribed more than the guidelines was not different among patients undergoing adrenalectomy compared to thyroid and parathyroid procedures. Our recommendations for pain control following MIS adrenalectomy is within acceptable range as they are consistent with other studies performed at other institutions.[7] The low dosing recommendation in our guidelines advocated for limiting pain control medications to over the counter acetaminophen/NSAIDS for thyroid/parathyroid as well as MIS adrenal surgery. However, the proportion of patients receiving only over the counter pain medications was higher for thyroid and parathyroid patients compared to adrenal surgery patients. While this can simply be due to higher pain levels associated with abdominal surgery compared to neck procedures, it can also be due to provider perceptions of more intense pain following MIS adrenalectomy procedures. Similarly, the proportion of adrenal surgery patients receiving opioid prescriptions based on the high dosing recommendations was higher compared to thyroid and parathyroid patients in the high dosing group. On the other hand, following guideline implementation, about 10% of all patients received opioids more than the guidelines, likely due to patient-specific factors that may have necessitated more pain control, rather than non-adherence.[8]

While these guidelines were effective in reducing opioid prescriptions, limiting opioid over-prescription, and maintaining stable refill rates, they can be further ameliorated. A significant proportion of patients received our “high” dose of opioids; while this practice was compliant with our guidelines, further actions are need to better optimize these guidelines and assure they match patient need. Moreover, after implementation, further assessment has shown that post-surgical pain following thyroid and parathyroid procedures can be managed without opioids for the majority of patients.[5,8–11] Further efforts to optimize opioid prescribing, including a focus on tapering, are needed as it is estimated that about 7% of patients undergoing endocrine surgery procedures are at risk of persistent long term opioid use.[12]

Table 8
Opioid Prescription Trends Among Opioid Naïve parathyroid Patients.

	Pre-guidelines	Post-guidelines	P-value
	N = 123	N = 108	
Any opioid prescription			<0.01
No	5 (4.1%)	30 (27.8%)	
Yes	118 (95.9%)	78 (72.2%)	
Opioid prescribed (MME)			<0.01
Median	112.5	50	
Q1, Q3	100.0, 150.0	0.0, 60.0	
Range	(0.0–375.0)	(0.0–150.0)	
Prescribed MME>200			<0.01
No	115 (93.5%)	108 (100.0%)	
Yes	8 (6.5%)	0 (0.0%)	
Opioid refill			0.13
No	122 (99.2%)	104 (96.3%)	
Yes	1 (0.8%)	4 (3.7%)	
Prescribing guidelines group			<0.01
Low	5 (4.1%)	30 (27.8%)	
Medium	0 (0.0%)	18 (16.7%)	
High	11 (8.9%)	50 (46.3%)	
Above High	107 (87.0%)	10 (9.3%)	
Prescribed > guidelines			<0.01
No	16 (13.0%)	98 (90.7%)	
Yes	107 (87.0%)	10 (9.3%)	

Our study is subject to some limitations as it is a retrospective study. Pre-surgery opioid users may not be captured if their opioid use was not documented in our records. In addition, patients provided with opioid prescriptions and refills outside the Mayo Clinic network may have been missed.

Conclusion

Opioid prescribing guidelines for endocrine surgical procedures decreased both the proportion of patients receiving opioids and the amount when prescribed, therefore further supporting the utility of opioid prescribing guidelines in decreasing over-prescription.

Declaration of competing interest

The authors report no proprietary or commercial interest in any product mentioned or concept discussed in this article. No outside funding for research was obtained for this project.

References

1. National Institute on Drug Abuse. Opioid overdose crisis. Available at: https://www.drugabuse.gov/drugs-abuse/opioids/opioid-overdose-crisis. Accessed March 27, 2020.
2. Habermann EB. Are opioids overprescribed following elective surgery? *Adv Surg*. 2018 Sep;52(1):247–256. PubMed PMID: 30098616. Epub 2018/08/14.
3. Thiels CA, Anderson SS, Ubl DS, et al. Wide variation and overprescription of opioids after elective surgery. *Ann Surg*. 2017 Oct;266(4):564–573. PubMed PMID: 28697049. Epub 2017/07/12.
4. Thiels CA, Ubl DS, Yost KJ, et al. Results of a prospective, multicenter initiative aimed at developing opioid-prescribing guidelines after surgery. *Ann Surg*. 2018 Sep;268(3):457–468. PubMed PMID: 30004924. Epub 2018/07/14.
5. Sada A, Ubl DS, Thiels CA, et al. Optimizing opioid-prescribing practices after parathyroidectomy. *J Surg Res*. 2020 Jan;245:107–114. PubMed PMID: 31415931. Epub 2019/08/16.
6. Sada A, Thiels CA, Britain MK, et al. Optimizing discharge opioid prescribing practices after mastectomy with immediate reconstruction. *Mayo Clin Proc Innov Qual Outcomes*. 2019 Jun;3(2):183–188. PubMed PMID: 31193969. Pubmed Central PMCID: PMC6543550. Epub 2019/06/14.
7. Tan WH, Yu J, Feaman S, et al. Opioid medication use in the surgical patient: an assessment of prescribing patterns and use. *J Am Coll Surg*. 2018 Aug;227(2):203–211. PubMed PMID: WOS:000439564700009. English.
8. Lou I, Chennell TB, Schaefer SC, et al. Optimizing outpatient pain management after thyroid and parathyroid surgery: a two-institution experience. *Ann Surg Oncol*. 2017 2017/07/01;24(7):1951–1957.
9. Lancaster E, Inglis-Arkell C, Hirose K, et al. Variability in opioid-prescribing patterns in endocrine surgery and discordance with patient use. *JAMA Surg*. 2019 Aug 14;154(11):1069–1070. PubMed PMID: 31411647. Pubmed Central PMCID: PMC6694384. Epub 2019/08/15.
10. Militsakh O, Lydiatt W, Lydiatt D, et al. Development of multimodal analgesia pathways in outpatient thyroid and parathyroid surgery and association with postoperative opioid prescription patterns. *JAMA Otolaryngol*. 2018;144(11):1023–1029.
11. Shindo M, Lim J, Leon E, et al. Opioid prescribing practice and needs in thyroid and parathyroid surgery. *JAMA Otolaryngol*. 2018;144(12):1098–1103.
12. Kuo JH, Huang Y, Kluger MD, et al. Use and misuse of opioids after endocrine surgery operations. *Annals of Surgery*. 13 Jan 2020. https://doi.org/10.1097/sla.0000000000003777. PMID: 31972644.