

Henry Ford Health

Henry Ford Health Scholarly Commons

Orthopedics Articles

Orthopedics / Bone and Joint Center

12-1-2021

Older, Male Orthopaedic Surgeons From Southern Geographies Prescribe Higher Doses of Post-Operative Narcotics Than do their Counterparts: A Medicare Population Study

Eric W. Guo

Henry Ford Health, eguo1@hfhs.org

Nikhil R. Yedulla

Henry Ford Health, nyedull2@hfhs.org

Austin G. Cross

Henry Ford Health, across1@hfhs.org

Luke T. Hessberg

Henry Ford Health, lhessbu1@hfhs.org

Kareem G. Elhage

Henry Ford Health, kelhage1@hfhs.org

See next page for additional authors

Follow this and additional works at: https://scholarlycommons.henryford.com/orthopaedics_articles

Recommended Citation

Guo EW, Yedulla NR, Cross AG, Hessburg LT, Elhage KG, Koolmees DS, and Makhni EC. Older, Male Orthopaedic Surgeons From Southern Geographies Prescribe Higher Doses of Post-Operative Narcotics Than do their Counterparts: A Medicare Population Study. *Arthrosc Sports Med Rehabil* 2021; 3(6):e1577-e1583.

This Article is brought to you for free and open access by the Orthopedics / Bone and Joint Center at Henry Ford Health Scholarly Commons. It has been accepted for inclusion in Orthopedics Articles by an authorized administrator of Henry Ford Health Scholarly Commons.

Authors

Eric W. Guo, Nikhil R. Yedulla, Austin G. Cross, Luke T. Hessberg, Kareem G. Elhage, Dylan S. Koolmees, and Eric C. Makhni

Older, Male Orthopaedic Surgeons From Southern Geographies Prescribe Higher Doses of Post-Operative Narcotics Than do their Counterparts: A Medicare Population Study



Eric W. Guo, B.S., Nikhil R. Yedulla, B.S., Austin G. Cross, B.S., Luke T. Hessburg, B.S., Kareem G. Elhage, B.S., Dylan S. Koolmees, B.S., and Eric C. Makhni, M.D., M.B.A.

Purpose: We wanted to evaluate opioid prescribing patterns among orthopaedic surgeons and to identify demographics that may be associated with more extensive opioid prescribing habits that could be candidates for targeted education policies. **Methods:** Medicare Part D prescriber and prescription information for the most recent available year, 2017, was accessed via a publicly available database offered by the Centers for Medicare and Medicaid. Number of total prescriptions, number of opioid prescriptions, and the total days' supply of opioids prescribed were analyzed for each of 19,219 orthopaedic surgeons. Demographics and board certification status were also recorded. **Results:** Orthopaedic surgeons who wrote the most opioid prescriptions (>400 per year) also wrote the longest prescription durations (14.1 days/prescription, $P < .05$ for all comparisons). Surgeons with more than 30 years of experience wrote the longest prescriptions (11.8 days/prescription; $P < .001$). Male surgeons wrote more opioid prescriptions than female surgeons (151 vs 95, respectively; $P < .001$). However, female surgeons wrote longer prescriptions than male surgeons (7.5 days/prescription vs 6.1 days/prescription, respectively; $P = .01$). Surgeons from southern states wrote the most opioid prescriptions (1,386,897) and the longest prescriptions, with an average of 13.0 days per prescription, whereas western states wrote the shortest prescriptions at 10.4 days per prescription ($P = .004$). **Conclusion:** There are demographic correlations between orthopaedic surgeons and opioid prescribing patterns. In particular, male, older southern surgeons prescribe the highest volumes of opioids. This provides an opportunity for targeted education versus overarching, general policies. Potential directions for future investigation can focus on assessing recent trends in opioid prescriptions among orthopaedic providers. **Level of Evidence:** Level III, retrospective cohort study.

We are in the midst of an opioid crisis that is unique to the United States, forcing physicians to reevaluate how they manage pain.¹⁻⁵ The Centers for Disease Control and Prevention estimate that the

number of overdose deaths involving opioids is 6 times higher than it was 20 years ago.⁶ On average, 130 Americans die every day from an opioid-related overdose.⁷ Health care providers have come under scrutiny as recent studies have described a trend of over-prescription that could be driving this epidemic.^{4,8-11}

A big driver of opioid prescriptions is through peri-operative and postoperative analgesia control.¹² Additionally, opioid medications play a significant role in the care of patients experiencing chronic pain and the postoperative management of those undergoing major surgeries.¹³⁻¹⁶ Although opioids can be instrumental in managing postoperative pain, they can also lead to dependence and corresponding adverse events in affected patients. Because of their high opioid prescription rates, orthopaedic surgeons represent a key demographic that could help alleviate the opioid burden. Orthopaedic surgeons could account for as much as 7.7% of all opioid prescriptions in the United

From the Department of Orthopaedic Surgery, Henry Ford Hospital, Detroit, Michigan, U.S.A.

The authors report the following potential conflicts of interest or sources of funding: E.C.M. reports other from Smith & Nephew and Springer. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

Received October 18, 2020; accepted June 29, 2021.

Address correspondence to Eric C. Makhni, M.D., M.B.A., Henry Ford Health System, Department of Orthopaedic Surgery, 2799 W. Grand Blvd, Detroit, MI 48202, U.S.A. E-mail: ericmakhnimd@gmail.com

© 2021 Published by Elsevier Inc. on behalf of the Arthroscopy Association of North America. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

2666-061X/201730

<https://doi.org/10.1016/j.asmr.2021.06.013>

States, ranking as the third highest prescribers despite constituting only 2% of the country's physicians.^{1,12,17} Orthopaedic surgeons, like all health care providers, face a challenging dilemma because they need to balance adequate pain management with appropriate opioid stewardship.

There is a need for more targeted research involving prescribing tendencies of individualized surgeons. The majority of opioid-prescribing guidelines in orthopaedics have been broad, overarching policies directed at the specialty as a whole. Identifying these high-volume cohorts could provide valuable insight into solutions for reducing the opioid burden. For example, major orthopaedics organizations can develop educational resources such as conference workshops or continuing medical educational courses that better inform orthopaedic surgeons on strategies to address opioid over prescription in the clinic.

This study uses a large publicly available database from the Centers for Medicare and Medicaid (CMS) that contains prescription drug information on physicians treating the Medicare population. The purposes of this study were to evaluate opioid prescribing patterns among orthopaedic surgeons and to identify demographics that may be associated with more extensive opioid prescribing habits that could be candidates for targeted education policies. The authors hypothesized that surgeon gender and geographical location have no impact on opioid prescribing patterns, but older surgeons are more likely to prescribe in higher volumes.

Methods

Medicare Part D prescriber and prescription information was accessed via a publicly available database offered by CMS. Data for the most recent year available, 2017, was accessed by the authors. The database was filtered to include all orthopaedic surgeons who made claims for prescription medication to Medicare Part D. The initial data set included 1 entry for each medication prescribed by each provider, for a total of 120,607 entries from 19,219 orthopaedic surgeons. The authors then filtered and examined the data set to record number of total prescriptions, number of opioid prescriptions, and number of total days' supply of opioids

prescribed by each orthopaedic surgeon. Days per prescription length was calculated by dividing the total number of days' supply by total number of prescriptions of the respective medicine. Prescription rate was calculated by dividing total number of opioid prescriptions by total number of prescriptions written per each provider or per region (i.e., 50 opioid prescriptions divided by 100 total prescriptions written would be an opioid prescription rate of 50%). CMS does not publicize individual medication prescription information if a provider writes 10 or less of that specific drug per year. Thus only medications for which a provider wrote 10 or more prescriptions for in 2017 were used in our analysis. According to the 2017 CMS methodology, 95 unique medications were considered to be opioids and resultantly evaluated as such.¹⁸

Demographic data was also collected. Location of practice was reported in the aforementioned database. Prescriber region was separated into Northeast, Midwest, South, and West as designated by the United States Census Bureau.¹⁹ Gender was determined by name or by searching for online profiles. The authors queried the American Board of Orthopaedic Surgery website²⁰ to determine board certification status and date of certification. The date of initial board certification was subtracted from the current date to calculate years of experience.

Independent samples *t*-tests and analysis of variance were used to compare continuous variables between groups. Pairwise comparisons were carried out on variables that were significant overall between groups. This included comparisons between years of experience, comparisons by average number of opioid prescriptions written per year, and comparisons between regions and between genders. Categorical variables were compared using χ^2 tests. Statistical significance was set at $P < .05$. All analyses were preformed using SPSS Version 25 (IBM, Armonk, NY)

Results

In 2017, 19,219 orthopaedic surgeons wrote a total of 5,717,089 prescriptions, of which 2,648,946 were for opioids (46.3%). These prescriptions accounted for a 33,470,791-days' supply of opioids. Of these 19,219

Table 1. Most Prescribed Opioids

Opioid	Total Days' Supply	Total No. of Prescriptions	% Of Total
Hydrocodone/acetaminophen	13,407,669	1,079,547	40.1
Tramadol	8,077,747	585,215	24.1
Oxycodone/acetaminophen	6,351,661	558,809	19.0
Oxycodone	3,178,710	241,231	9.5
Acetaminophen with codeine	1,186,679	109,717	3.5
Morphine sulfate	453,819	19,973	1.4
Other*	814,233	54,454	2.3

*Other opioids include buprenorphine, butorphanol, and methadone.

Table 2. Opioid Prescription Patterns by Average Number Of Prescriptions Written

Average No. of Opioid Prescriptions	No. of Orthopaedic Surgeons	Days per Prescription	Years of Experience, Mean
0-10	1526	—	20.5
11-100	9338	9.7	17.4
101-200	4402	10.4	18.2
201-300	1925	11.1	18.6
301-400	857	11.8	20.1
>400	1171	14.1	20.5

orthopaedic surgeons, 16,146 were board certified (84%). Average years of experience was 18.4. In total, 18,440 were men (96%), and 779 were women (4%). Of the 2,648,946 opioid prescriptions, the majority were written for hydrocodone/acetaminophen, tramadol HCL, and oxycodone HCL/acetaminophen. Hydrocodone/acetaminophen was the most prescribed opioid with 1,079,547 prescriptions written (40% of all opioid prescriptions). Tramadol HCL was the next-most prescribed opioid with 585,215 prescriptions written (24%), followed by oxycodone HCL/acetaminophen with 558,809 prescriptions (20%) (Table 1).

Nearly half of all orthopaedic surgeons wrote between 11 to 100 opioid prescriptions (49%) in 2017. Those who wrote the most opioid prescriptions (>400 per year) also wrote the longest prescriptions compared to the other groups (14.1 days/prescription; $P < .05$ for all comparisons). Orthopaedic surgeons who wrote between 11 to 100 prescriptions wrote the shortest length prescriptions (9.7 days/prescription) (Table 2).

Orthopaedic surgeons with more than 30 years of experience wrote the longest prescriptions (11.8 days/prescription; P values $< .001$) compared to the other groups with less years of experience. The groups with 11 to 20 and 21 to 30 years of experience had the highest proportion of prescriptions of more than 400 prescriptions per year (6.9% and 7.6%, respectively). These groups also had the lowest proportion of

orthopaedic surgeons prescribing fewer than 11 prescriptions per year (5.7% and 7.2%, respectively) (Table 3).

On average, men wrote more opioid prescriptions than women in 2017 (151 vs 95, respectively; $P < .001$). However, female surgeons wrote longer prescriptions than male surgeons (7.5 days/prescription vs 6.1 days/prescription, respectively; $P = .01$). In total, 1170 providers prescribed more than 400 opioid prescriptions, whereas 1535 prescribed less than 11. Overall, 6.8% of male prescribers prescribed at the upper extreme (>400), compared to 2.4% of female prescribers ($P < .001$), and 7.7% of male orthopaedic surgeons prescribed fewer than 11 prescriptions per year, compared to 14.6% of female orthopaedic surgeons ($P = .02$) (Table 3).

The South wrote the majority of opioid prescriptions (1,386,897) whereas the Northeast wrote the fewest (284,924). The West region had the highest rate of opioid prescription, whereas the Northeast had the lowest rate of opioid prescription (52% vs 41%, respectively; $P = .001$). Alaska had the highest rate of opioid prescriptions whereas New York had the lowest rate of opioid prescription (63.8% vs 30.5%; $P = .001$). The South wrote the longest prescriptions, with an average of 13.0 days per prescription, whereas the West wrote the shortest prescriptions at 10.4 days per prescription ($P = .004$) (Fig 1; Table 4)

Table 3. Opioid Prescription Patterns by Years of Experience and Sex

	Number	<11 Prescriptions*	>400 Prescriptions*	Mean No. of Prescriptions	Days per Prescription	Opioid Prescription Rate
Years of experience						
0-10 yrs	4987	7.9%	3.7%	119.6	10.1	59.1%
11-20 yrs	4385	5.7%	6.9%	156.3	10.1	57.3%
21-30 yrs	4161	7.2%	7.6%	163.9	10.4	54.8%
>30 yrs	2613	12.9%	6.1%	156.1	11.8	52.8%
Not board certified	3073	8.3%	6.7%	149.7	10.5	56.9%
Sex						
Male	18440	7.7%	6.2%	151.8	6.1	
Female	779	14.6%	2.0%	95.6	7.4	

*Denotes percentage of providers in each group writing less than 11 or more than 400 prescriptions.

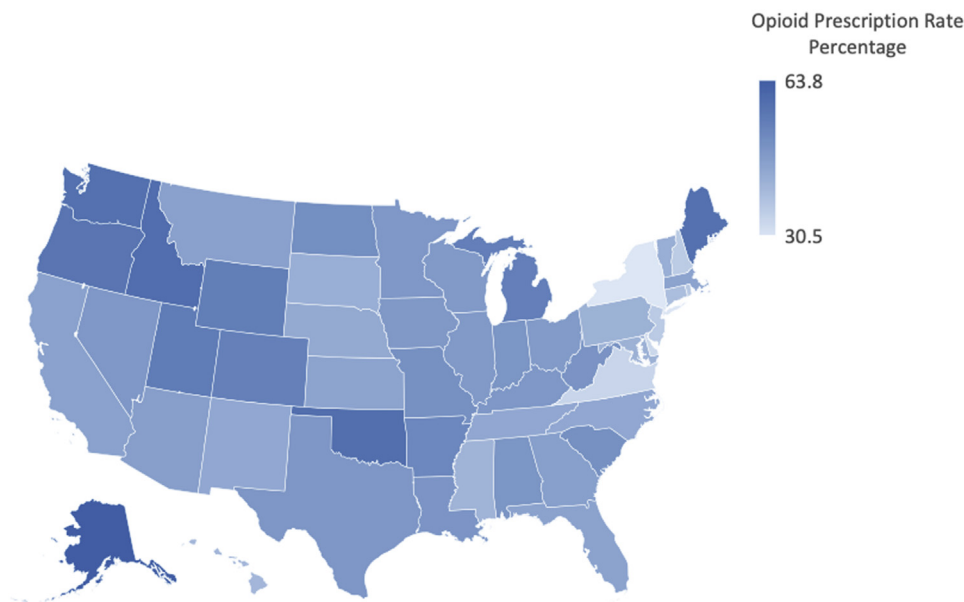


Fig 1. Opioid prescription rate by state. The opioid prescription rate percentage is designated by varying levels of shading as denoted by the key. Alaska had the highest opioid prescription rate (63.8%), whereas New York had the lowest prescription rate (30.5%), $P = .001$.

Discussion

This investigation highlights a lack of consensus in prescription patterns at both the regional and individual provider level. In addition, we identify key surgeon demographics associated with increased opioid prescribing habits. Our findings provide insight into opioid prescribing patterns among a large portion of orthopaedic surgeons in the United States. Because the opioid epidemic continues to be a pressing issue for physicians, understanding such trends can help shape initiatives to address these concerns moving forward.

There has been a growing body of recent literature describing overprescription of opioids after orthopaedic surgery procedures.^{15,21-23} A recent study evaluating opioid prescriptions after knee arthroscopy in both adults and pediatric patients found that on average, only one third of the opioids prescribed were actually used.¹⁵ Another study examining opioid use in children after surgical management of supracondylar humerus fractures found that patients were using less than 25% of prescribed opioids. They recommended that a prescription of 7 opioid doses after discharge would have been sufficient.²¹ These findings are concerning because unused opioid medication presents a risk for both diversion and misuse. Without concerted efforts to

standardize prescription lengths, overprescription is likely to continue.

The data in this analysis highlight a lack of consensus in opioid prescribing pattern at the level of individual orthopaedic surgeons that could be contributing to overprescription. Those who wrote the most prescriptions per year were the most aggressive in prescription length compared to those who wrote fewer prescriptions per year. Those providers writing 400 or more opioid prescriptions per year wrote prescriptions that were almost 4 days longer than those writing 11 to 100 prescriptions. Furthermore, orthopaedic surgeons who have been in practice for 30 or more years wrote prescription lengths that were almost 2 days longer than those in practice less than 30 years. These variable prescription lengths are especially alarming because a recent study found that duration of prescription as opposed to dosage is most strongly associated with opioid misuse in the postsurgical period, suggesting that there could be as much as a 20% increase risk for misuse for every additional week of prescription.²⁴ These findings highlight a lack of consensus among orthopaedic surgeons at the individual level and also present a key education opportunity. These providers who have been identified as heavy prescribers present a

Table 4. Opioid Prescription Patterns by Region

	No. of Opioid Prescriptions	Days per Prescription	Opioid Prescription Rate
Midwest	575,041	10.5	48.20%
Northeast	287,166	11.2	40.9%
South	1,401,963	13	46.20%
West	384,776	10.4	52%

cohort that would be attractive for targeted opioid stewardship education.

There also seems to be a lack of consensus in opioid prescription writing at the regional level. In the West, more than half of all prescriptions written by orthopaedic surgeons were for some form of opioid medication (52%), compared to only 40.9% in the Northeast. The authors hypothesize that this difference is likely due to the increasing popularity of opioid-sparing protocols among orthopaedic surgeons, with the Northeast having some of the strictest opioid prescription regulations in the country.²⁵ In the South, orthopaedic surgeons on average wrote longer prescriptions compared to the other 3 regions. Our results correlate a past study that also found different opioid prescription patterns by geographic location on the basis of dispensing information from 2008.²⁶ As previously mentioned, the variability in prescription length is concerning because a number of prior studies have suggested that length of opioid prescription is a key risk factor for opioid abuse.^{24,27,28}

This study corroborates other recent studies that have described variability in opioid prescription patterns of surgeons. In a large retrospective database study including 215,140 patients, the authors found wide variation in prescribing patterns for post-operative pain management. Of note, their recommended optimal lengths for opioid prescriptions were highly variable themselves, with wide ranges (4 to 13 days for women's health procedures, 4 to 9 days for general surgery procedures). For musculoskeletal surgeries, they recommended a prescription length of 6 to 15 days, stating that a 7-day limit could be inappropriately restrictive.²⁹ In another similar large retrospective database study of surgical urology patients, there was significant variation in prescribing patterns. The authors found a wide range of median opioid morphine equivalents (OME) given after a number of procedures with interquartile ranges as high as 150.³⁰ These studies highlight the widely variable opioid prescription patterns and the urgent need for consensus to reduce overprescription and decrease the opioid burden.

These data provide an opportunity for targeted education policies versus broad overarching regulatory guidelines. Because of the high volume of opioids prescribed by orthopaedic surgeons, there could be significant consequences from even the slightest of diversion of opioids from these providers. The aforementioned results suggest there are certain regions and physician cohorts that seem to prescribe longer opioid prescriptions. Policy makers can thus target these groups and regions in an effort to standardize opioid protocols and decrease the risk for diversion and misuse. Additionally, prominent orthopaedics organizations such as the American Academy of Orthopedic Surgeons and

American Orthopaedic Association can play a key role in instituting programs to educate providers on strategies regarding how to address this issue. Annual conferences can include symposiums and workshops that share knowledge on effective measures, whereas organizational leaders can also develop continuing educational programs that help providers develop a more comprehensive understanding of the issue over the long run.

A recent study by Boddapati et al.³¹ also investigated the opioid prescribing patterns of orthopaedic surgeons using the Medicare population. However, the authors did not use the most recently available data from 2017 in their analysis, which was included in the current study. Data from 2017 show that tramadol has surpassed oxycodone/acetaminophen as the second most prescribed opioid. Hydrocodone/acetaminophen remains the most prescribed opioid, and oxycodone/acetaminophen has fallen to the third most prescribed opioid. Also, Boddapati et al.³¹ did not investigate the influence of surgeon experience on opioid prescribing patterns. The current study found various significant relationships between surgeon experience and opioid prescribing tendencies as was previously noted. Finally, the current study further elucidates the differences in prescribing patterns among male and female surgeons (Table 3).

Limitations

This study holds certain limitations, such as how this dataset only examined the Medicare Part D Beneficiaries and not opioid prescriptions through Medicaid and private insurance plans. However, our analysis takes into consideration a large sample (47.4 million Medicare Part D beneficiaries in 2020 or 14.3% of the U.S. population), and there is an extensive body of literature that has analyzed this patient population that significantly contributes to the topic of opioid stewardship, limiting any suggested sampling bias.^{18,32,33} Additionally, older patients enrolled in Medicare Part D may presumably necessitate greater narcotics dosage because of increased frequency of intensive surgical procedures. Previous studies, however, suggest that age isn't associated with increased opioid prescription, indicating how age does not appear to be a confounder that affects opioid prescribing patterns and the legitimacy of our findings.^{34,35} Furthermore, there are limited available data regarding opioid prescriptions by orthopaedic surgeons through private insurance plans and Medicaid, making the inclusion of such information into our study not feasible. Thus our study methodology appears to be the most applicable means for assessing at-large trends in opioid prescription patterns at the national level, even though we do not consider all forms of insurance through which opioid prescriptions are made.

Our study does not take into consideration some factors that may impact opioid prescription patterns such as case load, case mix, diagnosis, subspecialty, and prescriptions made through midlevel staff and resident physicians. However, neither the CMS dataset nor any other available database to our knowledge contains any such comprehensive data, thereby limiting the ability to account for these variables. However, determining the impact of subspecialty case load, case mix, and more on opioid prescribing patterns is outside the scope of the current study and may be an important area of future investigation. Additionally, previous published research in other fields such as otolaryngology has similarly assessed opioid prescription patterns without specific evaluation of case volume and mix and prescriptions made by auxiliary medical staff, supporting the appropriateness of our methodology given the limitations in accessible data.³⁶

Conclusion

There are demographic correlations between orthopaedic surgeons and opioid prescribing patterns. In particular, male, older southern surgeons prescribe the highest volumes of opioids. This provides an opportunity for targeted education versus overarching, general policies. Potential directions for future investigation can focus on assessing recent trends in opioid prescriptions among orthopaedic providers.

References

- Mir HR, Miller AN, Obremskey WT, Jahangir AA, Hsu JR. Confronting the opioid crisis: Practical pain management and strategies. *J Bone Joint Surg Am* 2019;101:e126.
- Dart RC, Surratt HL, Cicero TJ, et al. Trends in opioid analgesic abuse and mortality in the United States. *N Engl J Med* 2015;372:241-248.
- Kauffmann R, Hidalgo C, Roessler E, et al. [Preventive medical examination in asymptomatic workers: design and initial outcome of an institutional program]. *Rev Med Chil* 1991;119:617-625.
- Soelberg CD, Brown RE Jr, Du Vivier D, Meyer JE, Ramachandran BK. The US opioid crisis: Current federal and state legal issues. *Anesth Analg* 2017;125:1675-1681.
- Kanouse AB, Compton P. The epidemic of prescription opioid abuse, the subsequent rising prevalence of heroin use, and the federal response. *J Pain Palliat Care Pharmacother* 2015;29:102-114.
- Centers for Disease Control and Prevention. Understanding the epidemic. <https://www.cdc.gov/opioids/basics/epidemic.html>. Accessed November 25, 2019.
- Centers for Disease Control and Prevention. CDC Wonder. <https://wonder.cdc.gov>. Accessed November 7, 2019.
- Skolnick P. The opioid epidemic: Crisis and solutions. *Annu Rev Pharmacol Toxicol* 2018;58:143-159.
- Manchikanti L, Sanapati J, Benyamin RM, Atluri S, Kaye AD, Hirsch JA. Reframing the prevention strategies of the opioid crisis: Focusing on prescription opioids, fentanyl, and heroin epidemic. *Pain Physician* 2018;21:309-326.
- Reider B. Opioid epidemic. *Am J Sports Med* 2019;47:1039-1042.
- Volkow ND, McLellan TA, Cotto JH, Karithanom M, Weiss SR. Characteristics of opioid prescriptions in 2009. *JAMA* 2011;305:1299-1301.
- Soffin EM, Waldman SA, Stack RJ, Liguori GA. An evidence-based approach to the prescription opioid epidemic in orthopedic surgery. *Anesth Analg* 2017;125:1704-1713.
- Ballantyne JC. Opioids for the treatment of chronic pain: Mistakes made, lessons learned, and future directions. *Anesth Analg* 2017;125:1769-1778.
- Bates C, Laciak R, Southwick A, Bishoff J. Overprescription of postoperative narcotics: A look at postoperative pain medication delivery, consumption and disposal in urological practice. *J Urol* 2011;185:551-555.
- Tepolt FA, Bido J, Burgess S, Micheli LJ, Kocher MS. Opioid overprescription after knee arthroscopy and related surgery in adolescents and young adults. *Arthroscopy* 2018;34:3236-3243.
- Livingston-Rosanoff D, Aiken T, Rademacher B, et al. Overprescription of opioids following outpatient anorectal surgery: A single-institution study. *Dis Colon Rectum* 2020;63:1541-1549.
- Morris BJ, Mir HR. The opioid epidemic: Impact on orthopaedic surgery. *J Am Acad Orthop Surg* 2015;23:267-271.
- Medicare Part D Opioid Prescribing Mapping Tool. Available at: https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Medicare-Provider-Charge-Data/OpioidMap_Medicare_PartD. Accessed June 16, 2021.
- United States Census Bureau. Vol 20202020.
- American Board of Orthopaedic Surgery. Verify Certification. Available at: <https://www.abos.org/portal/verifycertification.aspx>. Accessed June 16, 2021.
- Nelson SE, Adams AJ, Buczek MJ, Anthony CA, Shah AS. Postoperative pain and opioid use in children with supracondylar humeral fractures: Balancing analgesia and opioid stewardship. *J Bone Joint Surg* 2019;101:119-126.
- Premkumar A, Lovecchio FC, Stepan JG, et al. Characterization of opioid consumption and disposal patterns after total knee arthroplasty. *Bone Joint J* 2019;101-b:98-103.
- Bhashyam AR, Keyser C, Miller CP, et al. Prospective evaluation of opioid use after adoption of a prescribing guideline for outpatient foot and ankle surgery. *Foot Ankle Int* 2019;40:1260-1266.
- Brat GA, Agniel D, Beam A, et al. Postsurgical prescriptions for opioid naive patients and association with overdose and misuse: Retrospective cohort study. *BMJ* 2018;360:j5790.
- Padilla JA, Gabor JA, Schwarzkopf R, Davidovitch RI. A novel opioid-sparing pain management protocol following total hip arthroplasty: Effects on opioid consumption, pain severity, and patient-reported outcomes. *J Arthroplasty* 2019;34:2669-2675.
- McDonald DC, Carlson K, Izrael D. Geographic variation in opioid prescribing in the U.S. *J Pain* 2012;13:988-996.

27. Bedard NA, Pugely AJ, Westermann RW, Duchman KR, Glass NA, Callaghan JJ. Opioid use after total knee arthroplasty: Trends and risk factors for prolonged use. *J Arthroplasty* 2017;32:2390-2394.
28. Miller M, Barber CW, Leatherman S, et al. Prescription opioid duration of action and the risk of unintentional overdose among patients receiving opioid therapy. *JAMA Intern Med* 2015;175:608-615.
29. Scully RE, Schoenfeld AJ, Jiang W, et al. Defining optimal length of opioid pain medication prescription after common surgical procedures. *JAMA Surg* 2018;153:37-43.
30. Ziegelmann MJ, Joseph JP, Glasgow AE, et al. Wide variation in opioid prescribing after urological surgery in tertiary care centers. *Mayo Clin Proc* 2019;94:262-274.
31. Boddapati V, Padaki AS, Lehman RA, Lenke LG, Levine WN, Riew KD. Opioid prescriptions by orthopaedic surgeons in a Medicare population: Recent trends, potential complications, and characteristics of high prescribers. *J Am Acad Orthop Surg* 2021;29:e232-e237.
32. Kuo YF, Raji MA, Chen NW, Hasan H, Goodwin JS. Trends in opioid prescriptions among Part D Medicare recipients from 2007 to 2012. *Am J Med* 2016;129:221.e221-230.
33. Powell D, Pacula RL, Taylor E. How increasing medical access to opioids contributes to the opioid epidemic: Evidence from Medicare Part D. *J Health Econ* 2020;71:102286.
34. Bhashyam AR, Young J, Qudsi RA, Parisien RL, Dyer GSM. Opioid prescribing patterns of orthopedic surgery residents after open reduction internal fixation of distal radius fractures. *The Journal of hand surgery* 2019;44:201-207 e202.
35. Rhon DI, Snodgrass SJ, Cleland JA, Sissel CD, Cook CE. Predictors of chronic prescription opioid use after orthopedic surgery: Derivation of a clinical prediction rule. *Perioper Med (Lond)* 2018;7:25.
36. Svider PF, Arianpour K, Guo E, et al. Opioid prescribing patterns among otolaryngologists: Crucial insights among the medicare population. *Laryngoscope* 2018;128:1576-1581.