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# The impact of a curriculum on postoperative opioid prescribing for novice surgical trainees

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ABSTRACT

*Background:* Surgical residents are frequently responsible for prescribing postoperative analgesia, yet the vast majority are never formally educated on the subject.
*Methods:* A resident-led educational presentation on postoperative analgesia prescribing was provided to incoming surgical interns at a tertiary academic center. Pre- and post-surveys assessed comfort in prescribing postoperative analgesia. Following the educational intervention, opioid prescriptions during the interns' first two months were compared to that of the prior year's interns.
*Results:* Education was provided to 31 interns. Prior to the session, few interns felt comfortable prescribing opioids (20%) or non-opioid analgesia (32%). After the session, 96% felt more comfortable prescribing opioids and 91% more comfortable prescribing multi-modal analgesia. Interns who received education prescribed an average of 127.8 Morphine Milligram Equivalents (MME) per prescription, compared to 208.5 MME by the prior year's interns ($p < 0.01$).
*Conclusion:* Education on postoperative analgesia targeting interns can be effective in preparing trainees in effective and judicious analgesic prescribing.



## Introduction

The over-prescription of opioids by medical providers has been a significant contributor to the current opioid epidemic.[1] Since 1999, the amount of opioids prescribed has quadrupled, while the rate of opioid related deaths has increased five-fold.[2,3] Surgeons have played a significant role in this epidemic, often prescribing opioids for postoperative pain in quantities far in excess of what is needed.[4,5] The consequences that stem from overprescribing opioids are significant, including an increase of chronic opioid use,[6–8] diversion for illicit use,[9] and accidental overdose.[10]

At academic teaching centers, residents are frequently responsible for prescribing postoperative analgesia; however, trainees rarely receive training in this area. A prior needs assessment at our institution demonstrated that the vast majority of surgical residents have never received education on postoperative analgesia or opioid prescribing at any point during their training.[11] As a result of this education gap, analgesic prescriptions written by residents demonstrate both significant variation in dosing and underutilization of non-opioid alternatives.[4,12] This lack of education is a potential target in an effort to reduce reliance on and over-prescription of opioids.

In particular, surgical interns are a key audience for educational intervention. New interns are expected to write prescriptions for analgesia from day one, which places a tremendous expectation on the most clinically inexperienced residents. To address the need of novice surgical trainees for education on postoperative analgesia, and to ultimately mitigate the over-prescription of opioids, we developed a focused, educational curriculum for incoming surgical trainees and assessed its impact on comfort with and practice patterns of prescribing postoperative opioids. We hypothesize that intern comfort level prescribing postoperative analgesia will increase and opioid prescriptions will decrease when compared to historical comparisons.

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## Methods

### Study population

All categorical general surgery, preliminary general surgery, and designated surgical sub-specialty (urology, otolaryngology, plastic surgery, and orthopedics) interns starting in the 2017–2018 academic year at the study site – an academic, tertiary medical center – were included in the educational intervention. All surgical interns spend at least half their year on general surgery services.

### Course design

A resident-led, focused educational presentation on postoperative analgesia prescribing was provided to all incoming surgical interns during their orientation period, prior to beginning clinical duties. The curriculum was developed following Kern's six step curriculum development model.[13] The first three steps (problem identification, targeted needs assessment, and establishing goals and objectives) were accomplished in prior work.[11] Goals and objectives were developed by consensus among the authors.

The implementation phase of the curriculum began with basic epidemiology regarding the current opioid epidemic and a review of the literature regarding the over-prescription of postoperative opioids. The curriculum also included the pharmacology of common analgesics, multimodal analgesia strategies, specific dosing of opioids, recommendations of analgesia by type of operation based on the current literature, the use of Patient Controlled Analgesia (PCA), and management of suspected opioid overdose. A detailed outline of the course is provided in Table 1.

### Pre- and post-education assessment design

Prior to the didactic session, incoming interns answered a pre-education assessment regarding their previous training in postoperative opioid prescribing, their current beliefs of how to prescribe opioids, and their comfort in prescribing postoperative analgesia. After the education session, trainees were asked about the usefulness of the session, their change in comfort of prescribing postoperative analgesia, and the knowledge they acquired regarding pain management strategies.

### Measuring the impact of the curriculum

To assess the impact of the curriculum on actual postoperative opioid prescribing patterns, the last step in the Kern model of curriculum development, participant analgesic prescriptions were assessed. Charts of patients undergoing the three operations in which interns were most frequently involved (laparoscopic appendectomy, laparoscopic cholecystectomy, and total thyroidectomy) were extracted during the trainees' first two months (60 days) of clinical experience. All postoperative prescriptions written for oxycodone, hydromorphone, hydrocodone, codeine, and tramadol were converted into Morphine Milligram Equivalents (MME). As a reference, 5 mg of oxycodone is the equivalent of 7.5 MME. To reduce confounding of potentially complex hospital stays, only records of patients who were discharged within 48 h of surgery were included for evaluation.

Prescribing habits of interns who received the education (study interns) were compared to that of the prior year's interns (comparison interns), who did not receive the session. Opioid prescribing amounts by the comparison interns were also abstracted during their first two months of residency (academic year 2016–2017) for the same three operations.

### Statistical considerations

All analysis of continuous variables was conducted using the Student's t-test, and all categorical variables using the chi-squared test. Linear regression was utilized to compare the amount of opioid prescribed by study interns and prior interns. Regression analysis controlled for patient race, sex, age, insurance status, history of substance abuse, and history of chronic pain, as well as the type of operation. All tests were two sided and a p-value of less than 0.05 was consider statistically significant. Analysis was conducted using SAS 9.4 (Cary, NC). This study was approved by the Yale Human Investigations Committee.

**Table 1**
Outline of education session.

| |
|---|
| I. Background on Analgesia Management |
| A Introduction to WHO Analgesic Ladder |
| B Epidemiology of Opioid Epidemic |
| C Review of Literature on Current Prescribing Patterns of Surgeons |
| II. Non-Opioid Analgesics |
| A Pharmacology |
| B Recommended Dosing |
| C Adverse Reactions/Concerns |
| D Theory of Multimodal Analgesia |
| III. Opioid Analgesics |
| A Pharmacology |
| B Recommended Dosing |
| i Current literature on typical patient opioid needs after common operations |
| C Adverse Reactions/Concerns |
| i Warning Signs of Overdose |
| ii Use of Narcan Use of Narcan |
| IV. PCA |
| A Recommended Dosing |
| B Troubleshooting |
| C Adverse Reactions/Concerns |
| V. Nuts and Bolts |
| A How to use DEA Number |
| B How and When to Contact Pain Services |
| C Contacting Outpatient Chronic Pain Management |
| D How to Provide Discharge Instructions on Opioid Safety in Patient Electronic Discharge Paperwork |

## Results

### *Intern demographics*

A total of 31 interns received the educational intervention, of which 25 completed the pre-education assessment (81%) and 23 answered the post-education assessment (74%). Among those answering the pre-education survey, 44% were female, 40% were White, 12% were Black, 24% were Asian, and the mean age was 27.8 (SD 2.4). Eighty percent of the answering residents were graduates of US medical schools (Table 2).

### *Survey results*

Only 20% of interns felt comfortable (selected "Extremely" or "Somewhat" comfortable) prescribing opioids prior to the educational session, while the majority of interns (56%) felt uncomfortable (selected "Extremely" or "Somewhat" uncomfortable). Similarly, just 32% of interns felt comfortable prescribing non-opioid medications for analgesia (Fig. 1). No intern reported having any formal training specifically related to postoperative opioid prescribing, and only 2 interns (8%) reported having formal training of any sort in opioid management in medical school. One was from a US medical school and one was a foreign medical graduate. Free responses of these two individuals noted that one received education on the World Health Organization pain management guidelines during clinical rotations, and one received a course as a fourth-year medical student that provided an overview of opioid management. After the educational session, 96% reported that they felt more comfortable prescribing opioids, and 91% felt more comfortable prescribing multi-modal analgesia (see Fig. 1).

### *Demographics of patients prescribed analgesia by interns*

There was a total of 93 patients with prescriptions written by the comparison interns, and 113 written by the study interns. Demographics of the postoperative patients for whom interns wrote prescriptions for showed no difference between groups. Specifically, there was no difference in patient age or history of substance abuse or chronic pain (Table 3).

**Table 2**
Demographics of interns answering educational assessment survey.

| Demographic | N (%) |
|---|---|
| **Age** (Mean, SD) | 27.8 (2.4) |
| **Gender** | |
| Male | 13 (52) |
| Female | 11 (44) |
| Not Answered | 1 (4) |
| **Race** | |
| White | 10 (40) |
| Black | 3 (12) |
| Hispanic | 2 (8) |
| Asian | 6 (24) |
| Other | 2 (8) |
| Not Answered | 2 (8) |
| **Graduate of US Medical School** | |
| Yes | 20 (80) |
| No | 5 (20) |
| **Total** | 25 |

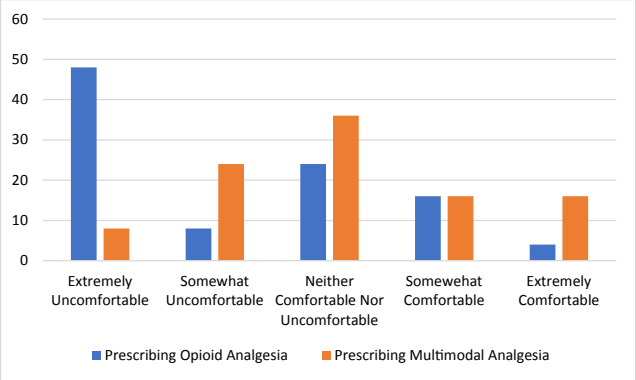



**Fig. 1. Intern Self-Reported Comfort with Prescribing Opioids and Multimodal Analgesia Prior to Didactic Session.** Percent of interns choosing their comfort with postoperative opioid (in blue) and multimodal (in orange) analgesic prescribing on a Likert scale from Extremely Uncomfortable to Extremely Comfortable, prior to the didactic session. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

### *Difference in opioid prescribing*

On average, the comparison interns prescribed 208.5 MME of opioid per prescription, compared to 127.8 MME by study interns ($p < 0.01$) (Table 3). Linear regression demonstrated that interns who received the educational session wrote an average total dose of postoperative opioids that was 83.8 MME less (95%CI -115.8 to −51.8 MME) than the comparison interns (Supplemental Table 1). For each of the three studied operations, the study interns wrote a significantly lower amount of opioid than comparison interns (Fig. 2, Supplemental Table 2). There was no difference in the types of opioid prescribed (Table 3).

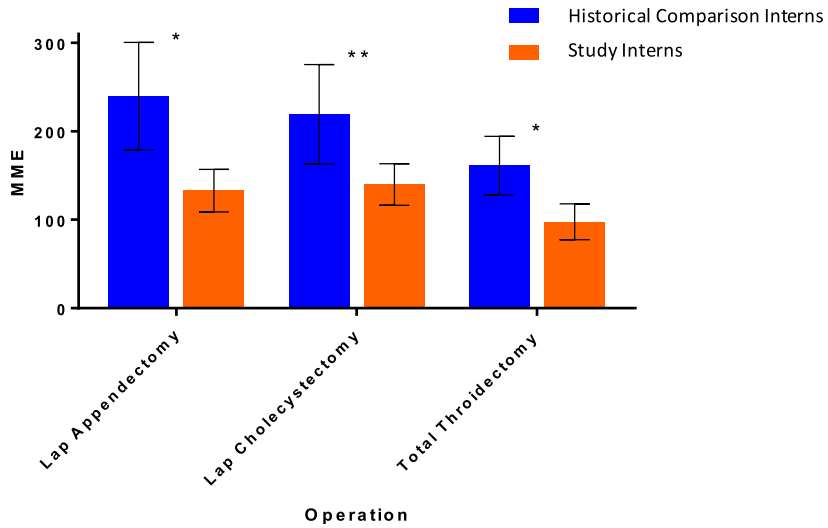
## Discussion

An educational intervention on analgesia management provided to novice surgical trainees is an effective way to reduce postoperative opioid prescribing. Compared to the prior year's comparison interns, the interns who received the education prescribed an average of 80 MME less opioid per postoperative prescription, or the equivalent of more than eleven 5 mg pills of oxycodone. This reinforces the significant impact educational efforts can have on postoperative prescribing, and ultimately the opioid epidemic. Prior studies have shown that educating surgeons on the typical amounts of opioids that patients used after common operations can be effective in reducing postoperative opioid prescribing.[14] Providers, and especially those without much clinical experience, may not understand the amount of opioid necessary to adequately treat pain, and therefore may err on the side of over-prescribing to prevent inadequate pain control or patient dissatisfaction. This points to the importance of proper education on postoperative analgesia management and the need for continued study in the typical amounts of opioid analgesia used by patients.

Surgical interns are an ideal group for an educational intervention on postoperative analgesia. Trainees are entering residency with minimal education on postoperative analgesia prescribing; only two interns of the 25 surveyed had any formal education on analgesia prescribing during medical school, and none had any education related specifically to postoperative analgesia. To their credit, medical schools across the country have responded to this knowledge deficiency by developing much needed curricula on opioid prescribing[15,16]; however, the specifics of postoperative analgesia are not often covered, and may be more effectively

**Table 3**
Demographics of patients prescribed postoperative analgesia by comparison and study interns.

| | Patients Prescribed by Comparison Interns (2016) | | Patients Prescribed by Study Interns (2017) | | P-Value |
|---|---|---|---|---|---|
| | N | % | N | % | |
| **Age** (Mean, SD) | 48.1 | 18.8 | 49.1 | 17.9 | 0.70 |
| **Gender** | | | | | 0.98 |
| Female | 55 | 59.1 | 67 | 59.3 | |
| Male | 38 | 40.9 | 46 | 40.7 | |
| **Race/Ethnicity** | | | | | 0.95 |
| Asian | 2 | 2.2 | 1 | 0.9 | |
| African American | 12 | 12.9 | 16 | 14.2 | |
| Hispanic | 20 | 21.5 | 26 | 23.0 | |
| White | 57 | 61.3 | 68 | 60.2 | |
| Unknown/Refused | 2 | 2.2 | 2 | 1.8 | |
| **Patient History** | | | | | |
| History of Substance Abuse | 4 | 4.3 | 2 | 1.8 | 0.28 |
| History of Chronic Pain | 22 | 23.7 | 19 | 16.8 | 0.22 |
| **Insurance** | | | | | 0.65 |
| Private | 44 | 47.3 | 56 | 49.6 | |
| Medicaid | 20 | 21.5 | 19 | 16.8 | |
| Medicare | 18 | 19.4 | 25 | 22.1 | |
| Self-Pay | 8 | 8.6 | 12 | 10.6 | |
| Other | 3 | 3.2 | 1 | 0.9 | |
| **Procedure** | | | | | 0.52 |
| Laparoscopic Appendectomy | 25 | 26.9 | 38 | 33.6 | |
| Laparoscopic Cholecystectomy | 42 | 45.2 | 49 | 43.4 | |
| Total Thyroidectomy | 26 | 28.0 | 26 | 23.0 | |
| **Amount of Opioid Prescribed** (MME, SD) | 208.5 | 151.4 | 127.8 | 74.1 | <0.01 |
| **Type of Analgesia Prescribed** | | | | | 0.06 |
| Tylenol only | 4 | 4.3 | 3 | 2.7 | |
| Tylenol with Codeine | 11 | 11.8 | 15 | 13.3 | |
| Hydrocodone | 12 | 12.9 | 5 | 4.4 | |
| Oxycodone | 58 | 62.4 | 78 | 69.0 | |
| Hydromorphone | 3 | 3.2 | 0 | 0.0 | |
| Tramadol | 5 | 5.4 | 12 | 10.6 | |
| **Total Patients** | 93 | | 113 | | |




*p<0.01
**p<0.05

**Fig. 2. Postoperative Opioid Prescribing Amounts (in MME) of Study Interns Compared to Comparison Interns.** A comparison of the amount of opioid prescribed (in MME) by study interns who received the educational session (blue) compared to the prior year's historical comparison interns (orange). Confidence intervals are provided, as well as indications of degree of statistical significance. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

targeted at interns specifically starting a surgical career. With that said, medical school is still an opportune time to begin teaching about postoperative analgesia management and the proper stewardship of opioids. To this end, we have piloted providing the same curriculum to fourth year medical students planning to enter procedure-oriented specialties, with hopes that they will be prepared with this knowledge as they enter their training programs across the country.

There were a number of limitations to this study. First, the follow up period evaluating prescription patterns was relatively short, and further study is needed to assess if the changes in prescribing are long lasting. Second, this was not a controlled trial, and there are other factors that could have influenced prescribing patterns. In particular, as the opioid epidemic continues to fill headlines, newer interns may be more aware of the dangers of overprescribing opioids and other outside factors, including senior residents and attendings, may have played an unmeasured role in influencing prescribing patterns. Additionally, other interventions such as Prescription Drug Monitoring Programs have become more widely utilized, which could influence prescribing habits.[17] Third, we are uncertain if the change in opioid prescribing behavior had negative consequences, namely if patients were prescribed insufficient analgesia; however, the amount prescribed is still more than patient reported usage for these procedures.[4] Fourth, our pre and post surveys were not matched, which could have strengthened the analysis. Fifth, this was a study of a single institution, and not all interns responded to our survey, pointing to the need for larger, multi-institutional studies. Finally, we were only able to capture prescription medications, and because many non-opioid analgesics are over the counter, we were unable to assess the rate at which interns encouraged multimodal, non-opioid analgesia.

Education on postoperative analgesia targeting incoming surgical interns fills an important educational need for new trainees. Training sessions on this topic can both improve the comfort levels of interns prescribing postoperative analgesia and help lower the amount of opioid provided. Tackling the opioid epidemic requires a multifaceted approach, and surgical resident education should play a significant role.

## Conflict of interest

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.amjsurg.2018.08.007.

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