



# A multi-institutional approach for decreasing narcotic prescriptions after laparoscopic appendectomy

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## Abstract

**Background** Appendicitis is a common indication for surgical hospital admission. Uncomplicated appendicitis is typically treated with surgical intervention, most commonly a laparoscopic appendectomy. As with many procedures, narcotic utilization is highly varied among surgeons for postoperative pain control. With the opioid epidemic and a demonstrated link between excessive narcotic prescriptions paving the way to dependence and addiction, it is more important than ever to decrease the circulation of these medications. We hypothesized that a perioperative, multimodal analgesia strategy coupled with monthly feedback reports comparing hospitals narcotic prescribing habits would decrease, and in some cases eliminate, the use of outpatient narcotics in adults after laparoscopic appendectomy.

**Methods** A quality improvement project was initiated to provide monthly feedback to surgeons on narcotic prescribing habits after adult laparoscopic appendectomies. A multi-hospital database was created to include adult patients that were diagnosed with acute appendicitis, treated with laparoscopic appendectomy, and discharged within 48 h of surgery. The database provided information regarding the number of narcotic doses prescribed on discharge. Participating hospitals selected a site champion who distributed monthly prescribing reports. A protocol was created and distributed to participating sites that provided a guideline for preoperative and postoperative pain medication management. The intervention period was 10/1/2019–3/31/2020. We utilized the preceding year's data (October 1, 2018–September 30, 2019) as the pre-intervention control group. We also compared results between local and distant sites to see if personal connection to surgeons influenced the results.

**Results** A total of 1785 appendectomies were performed during the study period at participating hospitals. The average number of prescribed narcotics decreased from 23.6 doses during the control period to 14.2 during the intervention ( $p < 0.001$ ). There was no change in the number of total narcotic prescriptions (8.9 vs 7.9%,  $p = 0.52$ ). Overall, the average number of narcotics prescribed decreased by 40% with similar decrease in average prescribed narcotics for local and distant hospitals, respectively (47.7% vs 42.1%). Average narcotic dose during the first 2 months of intervention at the local hospitals was 9.7 and 11.1 for the last 2 months of intervention ( $p = 0.69$ ). Average narcotic dose during the first 2 months of intervention at the distant hospitals was 19.5 and 13.4 for the last 2 months of intervention ( $p = 0.005$ ).

**Conclusion** A multimodal pain regimen combined with a monthly narcotic prescription report provided to prescribers decreases the average number of narcotic prescriptions after laparoscopic appendectomy. Local sites demonstrated immediate decrease in narcotic utilization compared to distant sites whose change occurred more gradually.

**Keywords** Narcotic avoidance · Opioid reduction · Appendectomy

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The overuse and abuse of prescription opioid medications has emerged in the last decade as a major public health crisis in the US. In 2018, it is estimated that 10.3 million individuals misused opioids and 9.9 million misused prescription opioids. Of these individuals, 2 million are reported to have opioid use disorder [1]. In a recent CDC report, it was noted that 81,000 deaths occurred in the US over 12 months as a result of drug overdose [2]. Overall, it has been estimated that over 80% of drug overdoses in the US involved opioids and over 12% involved prescription opioids [3].

As prescription opioids play a significant role in the available circulating opioids in the community, there has been increasing awareness regarding prescription practices in various specialties. Opioid prescription practices after surgery have been previously noted to be highly variable [4] and often excessive [5]. In a recent retrospective review of US claims data of over 18 million patients, it was noted that the prescribed opioids after surgery exceeded published recommendations for multiple indications [6]. It is established that prescription opioids are often an introductory agent prompting longer term opioid use disorder [7]. Thus, surgeon-driven perioperative prescribing practices is one area that should be modified since it contributes to the number of overall circulating opioids in the community.

Appendicitis is one of the most common indications for urgent surgery and its associated postoperative pain is commonly treated with narcotics. Approximately 370,000 patients undergo appendectomy each year in the US [8]. We created a quality improvement project to encourage changes in practice that would decrease narcotic prescribing practices after appendectomy. We chose to create a two-part intervention. One, recommend a perioperative pain regimen. Two, create a database to track the average number of narcotics prescribed by each participating institution and provide monthly feedback reports to surgeons regarding prescription practices. We speculated that prescription habits would change by providing surgeons with feedback regarding the number of narcotics being prescribed and allowing them to see their prescription habits compared to other facilities.

## Methods

### Study design

A quality improvement project was initiated to provide monthly feedback to surgeons on narcotic prescribing habits after adult laparoscopic appendectomies discharged within 48 h of surgery. A system wide database was created to include patients 18 years of age and older that were diagnosed with acute appendicitis, treated with laparoscopic appendectomy, and discharged within 48 h of surgery. The database provided information regarding the number of

narcotic doses prescribed on discharge for each patient as well as number of patients' prescribed narcotic medication. Hospitals that elected to participate in the quality improvement project selected a site champion who distributed their hospitals monthly prescribing reports. A protocol was created and distributed to participating sites that provided a guideline for preoperative and postoperative pain medication management (Supplemental Material 1). The intervention period was 10/1/2019–3/31/2020. We utilized the years of October 1, 2018–September 30, 2019 as the control group.

A total of eleven participating hospitals were included in this study. Three separate hospitals included in this study existed under the same hospital system and were geographically close in proximity but were assigned independent site champions and separate prescribing reports. For purposes of data analysis, these hospitals will be considered "local" hospitals in comparison to "distant" hospitals.

This study was conducted at 11 hospitals of various sizes across Oregon and Washington States.

### Ethical consideration

Approval for this study was obtained from the Institutional Review Board prior to statistical analysis of data. Patient privacy was protected throughout this study.

### Inclusion criteria

All patients of age 18 years or older who underwent laparoscopic appendectomy for appendicitis and discharged within 48 h were included in this study.

### Exclusion criteria

Patients who underwent laparoscopic appendectomy who were discharged more than 48 h after surgery were excluded from this study in an attempt to exclude patients with perforated appendicitis or postoperative complications. Patients under the age of 18 years were excluded.

### Data analysis

Chi-square tests were used for univariate analysis of two-group categorical values. Fisher's exact test was used in place of chi-square when expected values in the contingency table were less than five. Student's *T*-test or Wilcoxon rank-sum test was used for univariate analysis of continuous variables depending on the data normality. A *p* value of <0.05 was considered statistically significant. All analyses were done in SAS version 9.4 (SAS Institute Inc., Cary, NC, USA).

**Table 1** Percentage of prescribed narcotics

	Cases with no doses prescribed (%)	Cases with $\leq 10$ doses prescribed (%)	Cases with 11–20 doses prescribed (%)	Cases with $> 20$ doses prescribed (%)
Pre-intervention ( $n = 1472$ )	119 (8.1)	82 (5.6)	601 (40.8)	670 (45.5)
Intervention ( $n = 313$ )	22 (7.0)	146 (46.6)	100 (31.9)	45 (14.4)

## Results

A total 1785 appendectomies were performed during the study period at the participating hospitals. 1472 were performed during the control period and 313 were performed during the intervention period.

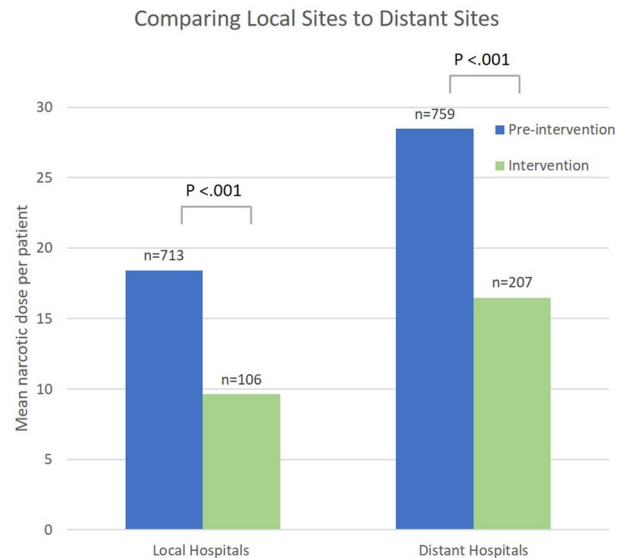
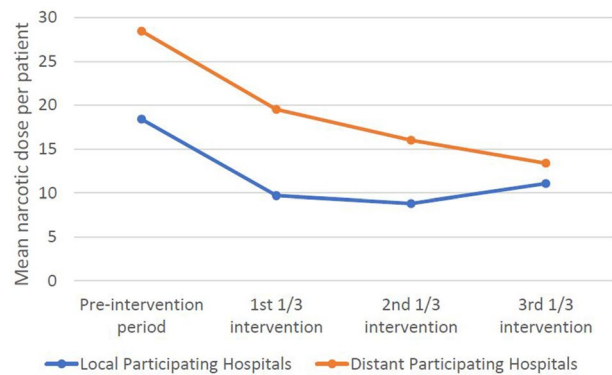
819 appendectomies were performed at one of the three local hospitals. 713 were performed during the control period and 106 were performed during the intervention period. 966 appendectomies were performed at distant hospitals. 759 were performed during the control period and 207 during the intervention period.

Average age of patients was 40.4 years for the pre-intervention group and 38.4 years for the intervention group ( $p = 0.0004$ ). Average postoperative length of stay was 16.6 h for the pre-intervention group and 13.6 for the intervention group ( $p = 0.0001$ ).

Percentage of patients receiving the recommended ten doses or less of prescribed narcotics was 13.7% in the pre-intervention group and 53.6% in the intervention group. Variations in narcotic prescribed during pre-intervention and intervention period are noted in Table 1. Average narcotic dose was 23.6 for the study group during the pre-intervention period and 14.1 for the study group during the intervention period ( $p = 0.0001$ ). 119 patients in the pre-intervention period (8.1%) and 22 patients in the intervention group (7.0%) received no narcotic prescription after appendectomy.

Average narcotic dose for the local hospitals was 18.4 during control period and 9.6 during the intervention period ( $p = 0.0001$ ). Average narcotic dose for the distant hospitals was 28.5 during the control period and 16.0 during the intervention period (Fig. 1). At the local hospitals, 50 patients in the pre-intervention period (7.0%) and 5 in the intervention period (4.7%) did not receive any narcotic prescription after appendectomy. At the distant hospitals, 69 patients in the pre-intervention period (9.1%) and 17 in the intervention period (8.2%) did not receive any narcotic prescription after appendectomy.

Average narcotic prescribed in the 1st month of intervention (after providing pain control recommendations for appendectomy but prior to providing monthly feedback reports) was 11.6 for the local and 17.8 for the distant hospitals. Figure 2 demonstrates the change in narcotic dose prescribed over time during pre-intervention and

**Fig. 1** Comparing local sites to distant sites**Fig. 2** Improvement over time: comparing local participating hospitals to distant participating hospitals

intervention period. Average narcotic dose during the first 2 months of intervention at the local hospitals was 9.7 and 11.1 for the last 2 months of intervention ( $p = 0.69$ ). Average narcotic dose during the first 2 months of intervention at the distant hospitals was 19.5 and 13.4 for the last 2 months of intervention ( $p = 0.005$ ).

## Discussion

Substance misuse disorder is now more prevalent than diabetes and is 1.5 times more prevalent than all cancer diagnoses [9]. According to the Centers for Disease Control, the total economic burden of prescription opioid misuse alone in the United States is \$78.5 billion a year which includes the cost of healthcare, loss of productivity, addiction treatment, and criminal justice involvement [3]. More pertinent to our practice, patients who are opiate users who undergo abdominal surgery are more likely than non-opiate users to have prolonged hospital stays, be discharged to rehabilitation facilities, have higher 30-day readmission rates and overall greater expenditures at 90 days [10]. Furthermore, literature has demonstrated increased risk of death in patients with opioid use disorder who undergo appendectomy [11]. Opioid misuse is intimately involved with surgical practice and therefore narcotic prescribing should be performed thoughtfully and measures should be enacted that decrease unnecessary narcotic prescriptions after surgery.

In the pediatric population, it has been shown that narcotic prescribing practices after appendectomy is variable [12, 13] and most patients do not require narcotic medication for adequate postoperative pain control [14–16]. Within our hospital system, a quality improvement project was enacted within the pediatric population with implementation of a perioperative multimodal pain guidelines and monthly feedback reports to surgeons detailing their prescription behavior. Intervention resulted in a decrease in both average narcotic prescribed postoperatively and number of patients prescribed no narcotic medication after laparoscopic appendectomy. Given the success of this quality improvement project, a similar intervention was enacted in the adult appendectomy population.

The findings of this study indicate that providing pain control guidelines and monthly feedback reports to surgeons is effective in decreasing the amount of narcotics prescribed after adult appendectomy. In this study, an overall 40% decrease in prescribed narcotics per patient was observed during a 6-month intervention period. Similar to prior studies evaluating postoperative prescription practices, the amount of narcotic prescribed after laparoscopic appendectomy was found to be highly variable in our study. While prescription practices remained variable with intervention, the percentage of appendectomy patients receiving the recommended number or fewer of narcotic medication doses increased from 13.7 to 57.6% with intervention.

Previous studies have shown that providing education to surgeons regarding recommended opioid prescribing guidelines with respect to common general surgery

procedures has been successful in decreasing postoperative narcotic prescriptions [17]. We find that an initial decrease was similarly noted after providing multimodal pain recommendations that included an opioid prescription recommendation of ten doses or fewer for laparoscopic appendectomy. This decrease, however, was more rapid in the local hospitals when compared to the distant hospitals. With subsequent monthly feedback reports, we noted a sustained decrease in the local participating hospitals and progressive decrease in the distant hospitals. The more rapid decrease in narcotic prescriptions noted in the local hospitals during the intervention period may be explained by the fact that the surgeons implementing this study personally knew the site champions and many of the surgeons at the local hospitals, thus, allowing for additional informal reminders regarding prescription practices and more personalization of feedback provided each month. At the distant hospitals, it was more difficult to provide this level of personalization and may have taken more time to develop personal relationships that allowed for an impact on prescribing behavior. In addition, by providing monthly feedback reports, increased awareness of lower narcotic prescribing practices at other institutions may have influenced higher prescribing institutions to lower their own postoperative narcotic prescriptions over time by invoking a competitive spirit among surgeons.

As a dramatic decrease in prescribed narcotic doses was noted in the local hospitals with providing recommendations alone, it is unclear whether providing monthly feedback reports was necessary for maintaining that change. However, for the distant hospitals, while initial recommendations alone affected some prescribing practice change, the monthly feedback reports allowed for further reduction in narcotic prescriptions. Despite the noted overall decrease of this approach, it should be noted that during intervention, 46% of laparoscopic appendectomy patients still received more than the recommended number of narcotic doses postoperatively during intervention. This could be secondary to difficulties in overcoming traditional prescribing habits, concern over potential decreases in patient satisfaction scores, or less engaging site champions.

During the study period, the intervention group had a reduced number of laparoscopic appendectomies compared to the control year. A possible explanation for this was the enrollment of some hospitals in the CODA trial permitting more liberal use of antibiotics rather than surgery for appendicitis. In addition, part of the study was impacted by the COVID-19 pandemic leading to a decrease in overall surgical case volume.

Weaknesses of this study include its retrospective nature and the limitations intrinsic to the database. Our database metric of including only patients who discharged within 48 h of surgery may not have controlled for all perforated versus

non-perforated appendectomies influencing the amount of narcotic pain medication prescribed. Our database was also limited with respect to patient factor data and individual prescriber data such as age of patient, comorbidities, narcotic dependence, and prescriber title (attending, resident, midlevel). Additionally, to allow for all participating hospitals to utilize their formulary medications, a perioperative medication regimen was recommended but not standardized.

Future studies should detail the frequency of post-discharge narcotic prescriptions and see if this is related to the initial prescription quantity. Additionally, further work should evaluate additional measures to more effectively decrease unnecessary narcotic prescribing postoperatively. Given the overall relative success of decreasing the number of narcotics prescribed quickly in the local hospitals in this study, perhaps future studies can examine measures aimed at increasing personalization of feedback regarding individual surgeon narcotic prescribing practices. Additionally, future quality improvement projects can expand this intervention to other common surgical procedures.

## Conclusion

Promoting perioperative pain management strategies and providing monthly prescribing feedback are effective in reducing narcotic doses prescribed at discharge after laparoscopic appendectomy.

**Supplementary Information** The online version contains supplementary material available at <https://doi.org/10.1007/s00464-022-09107-y>.

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## Declarations

**Disclosure** Dr. Robert Weinsheimer, Dr. Danielle Hayes, Dr. Mansen Wang, and Dr. Mimi Tan have no conflicts of interest or financial ties to disclose.

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