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Surgeon feedback to decrease opioid prescriptions after pediatric appendectomy

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Appendicitis is one of the most common indications for hospital admission and surgery within the pediatric population.[1] Approximately 70 000 appendectomies are performed annually, and the incidence is on the rise.[2 3] The initial decision point in treatment consists of operative versus non-operative management. Once the treatment team has decided to pursue surgery, laparoscopic appendectomy is the predominant approach with open appendectomy being performed much less frequently than in the past.[4] With advances in minimally invasive surgery, there have been fewer postoperative analgesic requirements with the ability to now avoid narcotics entirely in procedures, such as laparoscopic appendectomy.[5] Multimodal pain strategies have been well described within the adult and pediatric literature for postoperative pain control with an emphasis on minimizing or altogether avoiding narcotics. However, on discharge, patients are still often prescribed an opioid out of a desire to combat the "fifth vital sign": pain. Unfortunately, the unintended consequence of narcotic utilization has been a physician-enabled epidemic of addiction and overdose. This study was designed to test the hypothesis that a standardized, multimodal pain regimen combined with monthly reports detailing prescribing habits would significantly decrease the number of opioids prescribed at the time of discharge.

This study was a retrospective cohort study with preintervention and postintervention analysis of all laparoscopic appendectomies performed on patients aged 2–17 years at four institutions within a 31-hospital system. The four institutions selected were those serving the highest volume of pediatric patients in the system. In collaboration with partner institutions within the same health system and utilizing Tableau Software (an interactive data visualization tool), a quality improvement (QI) database was created which tracked all appendectomies across the system. Data were collected on the first cohort of patients who underwent surgical intervention between January 2017 and December 2017, and data from the second cohort were collected on surgeries from July 2018 through December 2018. There was a gap between the control and intervention time because some institutions had already begun to implement narcotic-reducing strategies at the beginning of 2018. To assess more accurately the true difference in narcotic prescribing before even small changes had been implemented, the period of January through December 2017 was utilized as the control. Data points included patient characteristics, diagnostic imaging patterns, treatment modalities, and, most pertinent for this study, opioid prescribing habits from each site.

A QI team was established among the institutions, which consisted of a champion at each site joined by various providers involved in the postoperative care of pediatric patients. The initial launch of the study intervention involved a video conference among the sites describing the purpose of the study and the methodology; however, no formal training program was utilized. Surgeons involved included 14 pediatric board-certified surgeons at four different sites. Using an initial video conference, the QI team collaborated to establish a standardized, multimodal pain regimen and guidelines for this study. In keeping with most protocols, they emphasized the use of local anesthesia, acetaminophen, non-steroidal anti-inflammatory drugs (NSAIDs), and consideration of additional medications before resorting to opioids, of which oxycodone was preferred. The typical dose of oxycodone used was a 5 mg pill for children greater than 49 kg, and weight-based dosing using liquid form (0.1 mg/kg up to 5 mg of a 1 mg/mL oxycodone solution). Number of prescribed doses for liquid formulation

was calculated by dividing the dispensed volume by the lowest range of prescribed dose. In addition to the standardized pain regimen, each site was provided with guidance on discharge instructions. These included educating parents and patients on realistic expectations of pain management, the utility of acetaminophen and NSAIDs, and the downsides of using opioids.

SAS V.9.4 (SAS Institute, Cary, North Carolina, USA) was used for all data analyses. For continuous variables, after checking normality, mean±SD were reported and unpaired t-tests were performed to compare the difference between groups. For categorical variables, counts and percentages were reported and χ^2 tests or Fisher's exact tests were performed to compare between groups. All tests were two-sided, and p-values less than 0.05 were considered as statistical significance.

Monthly reports that detailed the prescribing habits of each site were emailed to each site champion to share with their team. The report included all sites with complete transparency so that Hospital A could see the prescribing habits of Hospitals A–D. The monthly report was sent only to the site champions, so it was not possible to assess how many additional team members read it. The reports were provided for a total of 6 months, and then querying the same dashboard—postreport data were collected. The primary endpoint was the average narcotic dose at the time of discharge. The secondary endpoint was the percentage of patients who received no narcotics at the time of discharge. Additionally, a subgroup analysis was performed at different trimesters of the intervention.

During the period specified, a total of 651 laparoscopic appendectomies were performed at the four institutions. The multimodal pain regimen and feedback reports were implemented in August 2018. Data were collected after 6 months, and the intervention group consisted of 160 patients. The average age of all patients was 11.6 years and was not significantly different between the two groups. The average dose at the time of discharge for the control group was 9.68 doses, whereas that for the intervention group was 2.61 doses (p<0.001). The percentage of patients that received narcotics at discharge decreased from 65% to 23% (p<0.001). To evaluate the impact of prescription feedback over time, a chronological subanalysis of the intervention group was completed. During the first third of the intervention, the average dose at discharge was 3.33 doses, and 27.3% of patients received narcotics. By the final third, the average dose at discharge was 0.87 doses, and 14.8% of patients received narcotics at the time of discharge (table 1).

The data were used for subgroup analysis to compare prescribing practices between the first and last third of the intervention timeline (July through December 2018). This analysis was performed to assess whether the greatest impact on prescribing was more related to initial meeting with the QI team/providers about goals of decreasing narcotic utilization at the beginning of the intervention versus ongoing, regular feedback via the monthly reports. The average quantity of narcotic doses prescribed over the intervention period was 2.6. During the first third of the intervention period, the average dose had decreased to 3.33 and continued to decrease to 0.87 for the last third (p=0.0241).

Within the pediatric population, appendicitis is one of the most common diagnoses resulting in hospitalization and surgical intervention. Traditionally, opioids played a prominent role in postoperative pain control in an effort to fully address what has been described as the "fifth vital sign" pain. However, the opioid epidemic and the efficacy of multimodal strategies avoiding narcotics necessitate an overhaul of this approach to postoperative pain management. Any safe alteration in care that prevents an opportunity for addiction should be adopted. Minimally invasive procedures, such as laparoscopic appendectomy, represent an excellent place for surgeons to begin participating in this paradigm shift. The downside to opioids is well cited in the literature. This includes immediate side effects, such as nausea, vomiting, pruritus, and constipation, and the potential life-threatening effect of respiratory depression.[6] Opioid use among pediatric patients has also been shown to have long-term consequences. Bennett *et al* reviewed persistent opioid use after surgery among the pediatric population and showed that up to 15% of patients were still using narcotics 3 months after surgery.[7] In addition to the direct effect on the patient, overprescribed opioids are also cycled into the

Table 1 Comparison of average narcotic dosing and rate of opioid prescriptions at discharge

Metric	Control (n=491)	Intervention (n=160)	P value	First 1/3 of intervention (n=55)	Last 1/3 of intervention (n=54)	P value first 1/3 vs last 1/3 (non-parametric)
Average number of doses per total	9.68±11.71	2.61±6.11	0.0001	3.33±7.57	0.87±2.2	0.0241
Count of patients prescribed narcotics at discharge (%)	322 (65.6%)	37 (23.1%)	0.0001	15 (27.3%)	8 (14.8%)	0.111

*Continuous variables reported above with use of unpaired t-test for statistical analysis. Categorical variables used counts and percentages with the use of χ^2 or Fisher's exact tests to compare between groups. P values less than 0.05 were considered as statistical significance.

community. Data obtained by the National Survey on Drug Use and Health showed that 50% of prescription pain medications taken recreationally were sourced from a friend or relative. Within that same dataset, there were 1.2 million adolescents who misused prescription pain medications within 1 year.

In the past two decades, there have been significant efforts to decrease narcotic utilization. These include standardized, multimodal pain regimens; patient and parent education strategies; consensus guidelines around appropriate postoperative narcotic dosing; and studies assessing the efficacy of such efforts. Cairo *et al* recently showed that educational interventions and a standard opioid protocol in children after laparoscopic appendectomy resulted in a significant decrease in opioid prescriptions without an increase in emergency department visits or phone calls, with 94% of patients stating they had adequate pain control.[8]

This study demonstrates that a standardized, multimodal pain regimen paired with monthly data feedback results in a significant decrease in opioids prescribed at the time of discharge. The study approaches the problem from a different angle by providing surgeon feedback to elicit a change in prescribing habits. An easily accessible report was provided to physicians each month detailing their narcotic utilization for postoperative pain. The participating surgeons acknowledged that a sense of competition both in comparison to peers and in relation to their own historical performance fueled a drive to decrease narcotic prescriptions. When comparing the narcotic doses after the first third and last third of the intervention, there continued to be an ongoing decrease in average narcotic dosing between the two different time intervals, suggesting that steady monthly feedback was an important driver opposed to merely the initial meeting and protocol development. Consistently reminding providers about practice habits and comparing them to their peers helped to provide an ongoing stimulus for improvement. This in conjunction with our standardized pain regimen clearly had a significant impact. During a 6-month period, this modest QI project removed 1131 narcotic doses from circulation. This effort was limited to just four centers for a single diagnosis, meaning there is significant potential to use such a strategy on a larger scale to create a much more significant impact.

This intervention proved quite successful on a small scale involving only four high-volume pediatric centers. The majority of the project, data collection, and analysis were completed by a single attending and resident at one of the four institutions. There was minimal involvement of other support staff in the education, development of the protocol, data collection, and analysis making it a simple yet clinically effective project in the realm of QI. Theoretically, this could easily be scaled up. Furthermore, such a project has the potential to be even more effective with support staff to optimize patient communication, to conduct patient and surgeon follow-up, and to assure the dissemination of reports to all participating surgeons.

The limitations of this study include that it was a retrospective data analysis following a QI initiative. In addition to the retrospective analysis, there was no formal follow-up with patients or their families regarding frequency of seeking narcotic medications after discharge or need for readmission. Anecdotally, the participating surgeons reported zero instances of their patients seeking pain medication prescriptions after discharge. Additionally, the degree to which the monthly reports were viewed by prescribing surgeons was not determined, and our comparison did not specifically compare prescribing habits between hospitals or at the level of the individual provider, which may have played a role.

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