



## Pediatric Surgery

National variation in opioid prescribing after pediatric umbilical hernia repair<sup>☆</sup>

Randi S. Cartmill, MS\*, Dou-Yan Yang, PhD, Sara Fernandes-Taylor, PhD,  
Jonathan Emerson Kohler, MD, MA

Department of Surgery, University of Wisconsin-Madison, WI

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## ABSTRACT

**Background:** Pediatric umbilical hernia repair is a common procedure that requires minimal tissue disruption. We examined variation in opioid prescription fills after repair of uncomplicated umbilical hernias to characterize the types and doses of medication used and persistent postsurgical use.

**Methods:** Using the Truven Health Analytics MarketScan® Research Database for June 2012–September 2015, we identified pediatric patients undergoing umbilical hernia repair. We excluded patients with obstruction, gangrene, an earlier repair or a concurrent surgical procedure, and those without available pharmacy claim data. Analyses describe filled outpatient prescriptions by age, geographic region, drug type, quantity, and second prescriptions/refills.

**Results:** Of 4,407 procedures performed, 2,292 patients (52%) filled a prescription for postoperative opioids (age 0–1 years: 21.6%, age 2–3 years: 51.5%, age 4–5 years: 54.3%, 6 years or older: 57.9% [ $P < .0001$ ]). In the northeast United States, 42% of patients filled narcotic prescriptions, compared with 59% of patients in the south ( $P < .0001$ ). Hydrocodone/acetaminophen was most commonly prescribed (51%), followed by codeine/acetaminophen (30%). Durations were  $\leq 3$  days (50%), 4–10 days (46%), and  $> 10$  days (4%). A total of 6% of patients filled a second opioid prescription within 30 days.

**Conclusion:** Although many patients do not require opioids for umbilical hernia repair, most pediatric patients fill opioid prescriptions, including for prolonged courses and refills. Guidelines for appropriate prescribing of opioids after common, simple procedures, such as umbilical hernia repair, could improve the quality of care for children and impact the US epidemic of opioid abuse.

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Overuse and misuse of prescription opioids continue to be major public health concerns in the United States. An estimated 19% of Americans received an opioid prescription in 2016,<sup>1</sup> and 16% of pediatric Medicaid patients in Tennessee filled such a prescription in 2014.<sup>2</sup> Among the most common reasons for opioid prescribing is postsurgical pain;<sup>3,4</sup> however, the type of medication, dose, and prescription duration provided after surgery vary widely, even for a single ambulatory procedure.<sup>5–7</sup> Fujii et al<sup>7</sup> described the interquartile range (IQR) in total amount of opioids prescribed to adults after a variety of outpatient surgeries, including laparoscopic cholecystectomy (120–240 morphine milligram equivalents [MME], median 160), knee arthroplasty (113–480 MME, median 300), hernia repair (96–225 MME, median 160), partial mastectomy (0–160

MME, median 96), and carpal tunnel release (0–119 MME, median 75). Similarly, the amount of opioids prescribed to adolescents after ambulatory surgery varies widely for specific procedures and can lead to persistent opioid use.<sup>8,9</sup>

Patients are commonly prescribed more opioids than necessary. A systematic review of adult patients<sup>10</sup> found that 42%–71% of opioid tablets went unused after surgery. Pediatric patients were found to use half or less of their postoperative opioid prescriptions,<sup>8,11</sup> and for minor abdominal, genitourinary tract or peripheral procedures, they were found to use an average of 13%.<sup>12</sup> Adults were prescribed a median of 80 MME (IQR: 68–113) after an umbilical hernia repair, of which a median of 9 MME were used.<sup>7</sup> Unused opioids are frequently misused or diverted,<sup>5,7,8,10,11,13</sup> and misused opioids are most commonly obtained free from friends and family.<sup>14</sup>

Even when used as prescribed, opioid prescriptions can have negative effects on children. One study found that 75% of opioid-related adverse events in children occurred without evidence of deviation from prescribed use.<sup>2</sup> Pediatric patients can experience respiratory depression, which is exacerbated by the specific danger

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\* Corresponding author: Wisconsin Surgical Outcomes Research Program (WiSOR), University of Wisconsin School of Medicine and Public Health, K6/1175 CSC, 600 Highland Avenue, Madison, WI 53792-1690.

E-mail address: [cartmill@surgery.wisc.edu](mailto:cartmill@surgery.wisc.edu) (R.S. Cartmill).

of codeine hypermetabolism in some children.<sup>15</sup> The US Food and Drug Administration (FDA) recently released a black box warning for tramadol for the same reason.<sup>16</sup> In addition, recent research<sup>17,18</sup> has shown rising rates of accidental opioid overdoses by young children, some of which occur from taking their own prescribed medication.<sup>2</sup> Finally, a small but non-negligible percentage of opioid-naïve patients become persistent opioid users after receiving a postsurgical prescription,<sup>19,20</sup> notably teenagers<sup>9</sup> and those with psychological comorbidities.<sup>21</sup>

This study is focused on opioid prescribing after umbilical hernia repair, a common surgical procedure in young children. Postsurgical pain is the primary reason for opioid prescriptions in children 5 years of age and younger.<sup>2,22</sup> Umbilical hernias are a common diagnosis, occurring in 15%–23% of newborns,<sup>23,24</sup> and most repairs are elective because complications such as incarceration or gangrene are rare.<sup>25</sup> Umbilical hernia repair is a comparatively minor procedure, most often performed at age 5 years or younger, with minimal tissue disruption. Although no formal postoperative prescribing guidelines exist, patient information provided by the American College of Surgeons indicates that parents should expect their children to be discharged with only non-narcotic pain relief after this surgery.<sup>26</sup> We therefore chose to focus on this single common procedure—uncomplicated umbilical hernia repair—as a case study for examining opioid prescribing practices for young children after minor ambulatory surgery.

## Methods

### Data

We used the Truven Health Analytics MarketScan® commercial claims and encounters database to identify patients undergoing outpatient pediatric umbilical hernia repairs performed between July 2012 and September 2015. The MarketScan database is a large convenience sample of claims data for employer-sponsored insurance, covering millions of pediatric patients each year. The database includes claims for inpatient and outpatient care and pharmacy. We excluded cases for which pharmacy claims data were not provided. We identified patients under the age of 18 years, with umbilical hernia repairs (International Classification of Diseases, ninth revision [ICD-9] procedure codes 53.41, 53.42, 53.43, or 53.49 or Current Procedural Terminology [CPT] code 49580 or 49585) and excluded those with diagnoses of obstruction (ICD-9 code 552.1) or gangrene (ICD-9 551.1). Because repairs can be part of another procedure (eg, laparoscopy) or performed while the patient was under anesthesia for another surgery requiring postoperative opioids, we excluded cases where the umbilical hernia repair was performed on the same day as another procedure. Finally, we excluded a small number (0.9%) of cases occurring within days of birth in which umbilical hernia repairs were most likely miscoded.

The primary outcome variable was a filled outpatient prescription for opioids within 30 days of the index procedure. To avoid the potentially confounding effect of previous opioid exposure, we excluded a small number of cases (1%) in which the patient had filled an opioid prescription 90–7 days before the procedure. We considered prescriptions filled in the 6 days before the procedure to potentially be early fills in preparation for the surgery. Secondary variables included specific opioid medications prescribed, number of days' supply of the opioid medication, and whether the patient received a second opioid prescription within 30 days after the hernia repair. Data were available on opioid dosing, but analysis was complicated by inaccuracies in reporting and the fact that weight data were unavailable for patients. We therefore chose to use days' supply as the best available measure of prescription size. Urban is defined as patient residence in a metropolitan statistical

**Table 1**  
Filled opioid prescriptions by age.

Age (years)	Procedures	Opioid fills		P value
		Number	%	
0–1	454	98	21.6	< .001
2–3	771	397	51.5	
4–5	1,493	810	54.3	
6 or older	1,666	964	57.9	
Total	4,384	2,269	51.7	

**Table 2**  
Opioid prescriptions by region.

US region	Procedures	Opioid fills		P value
		Number	%	
Northeast	593	246	41.5	< .001
Midwest	1,055	528	50	
South	1,967	1,169	59.4	
West	664	285	42.9	
Total	4,279*	2,228	52.1	

\* Geographic data were unavailable for some cases.

area (MSA), as defined by the US census. Census definitions were used for region.

### Analysis

The data set was compiled using SAS (version 9.4, SAS, Cary, NC). The analyses were performed using Stata (version 15, Stata-Corp, College Station, TX), including descriptive statistics and  $\chi^2$  significance testing, with an  $\alpha$  level of  $P < 0.05$ .

## Results

A total of 7,882 children who had umbilical hernias repaired in the 39-month study period were identified in the MarketScan commercial claims database. We excluded 881 patients without available pharmacy data; 363 who received diagnoses of incarceration or gangrene; 2,158 who had multiple procedures on the day of the surgery; 73 who were likely miscoded as having the repair shortly after birth; and 23 who were not opioid-naïve, leaving 4,384 cases in the analysis dataset. (Fig. 1.)

More than half of pediatric umbilical hernia patients (52%) filled a prescription for an opioid. Almost all (96%) were filled on the day of surgery. The rate of prescription fills varied significantly through time, from 47% in 2012 to a high of 56% in 2014, then declining to 52% in 2015 ( $P = .001$ ). The rate of opioid fills varied significantly by age, increasing steadily from 22% of patients 1 year of age or younger to 58% of patients 6 years of age or older (Table 1).

Filled opioid prescriptions show wide geographic variation. Urban and rural residents were equally likely to fill an opioid prescription (52% and 51%, respectively), but rates varied significantly by census region, from 42% in the Northeast to 59% in the South. (Table 2). A substantial degree of variation was found across MSAs. Figure 2 presents the rate of prescription fills for pediatric patients in MSAs with 50 or more uncomplicated umbilical hernia repairs reported in the MarketScan database. Each region had substantial variation among MSAs. New York City had the lowest rate (21% of patients filling opioid prescriptions), but Philadelphia had a rate almost three times higher (62%). Similarly, the rate in the South varied from 25% in Miami to 92% in Columbia, SC.

Pediatric patients received one of five of the following opioid medications: codeine with acetaminophen (also known as acetyl-para-aminophenol [APAP]), hydrocodone with APAP, oxycodone, oxycodone with APAP, or tramadol (Table 3). Prescriptions were in the form of both tablets and liquid solutions. The most

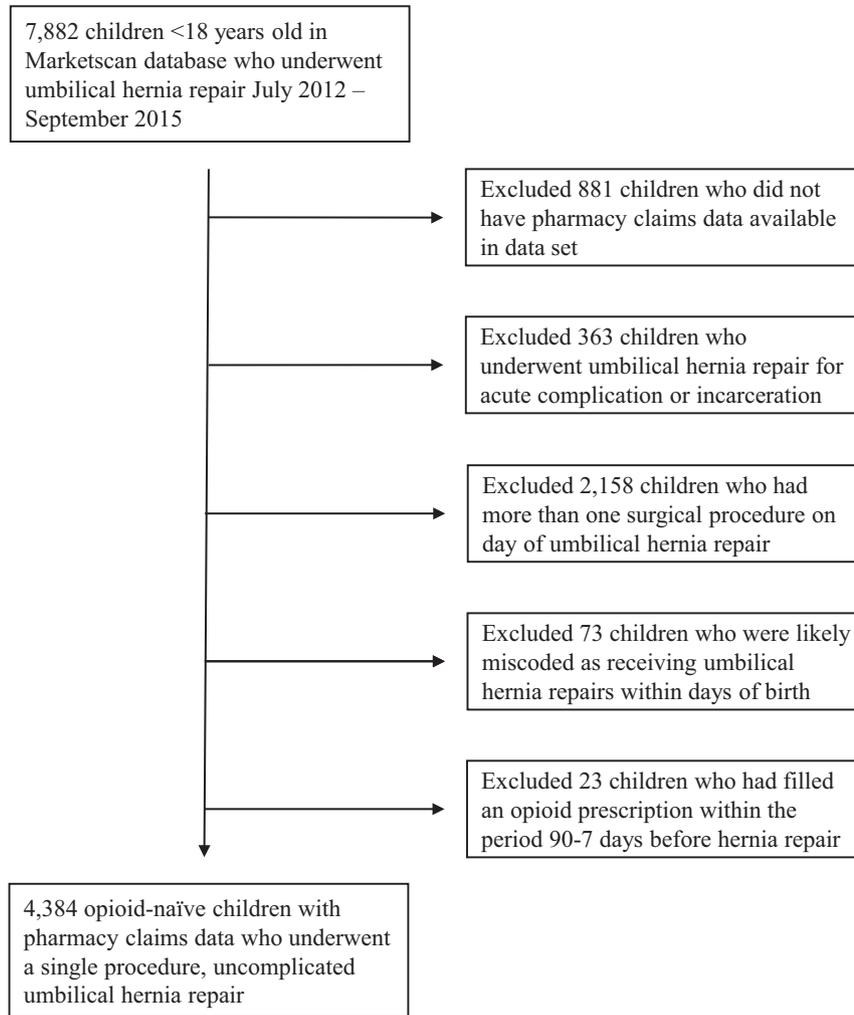


Fig. 1. Study design and excluded patients.

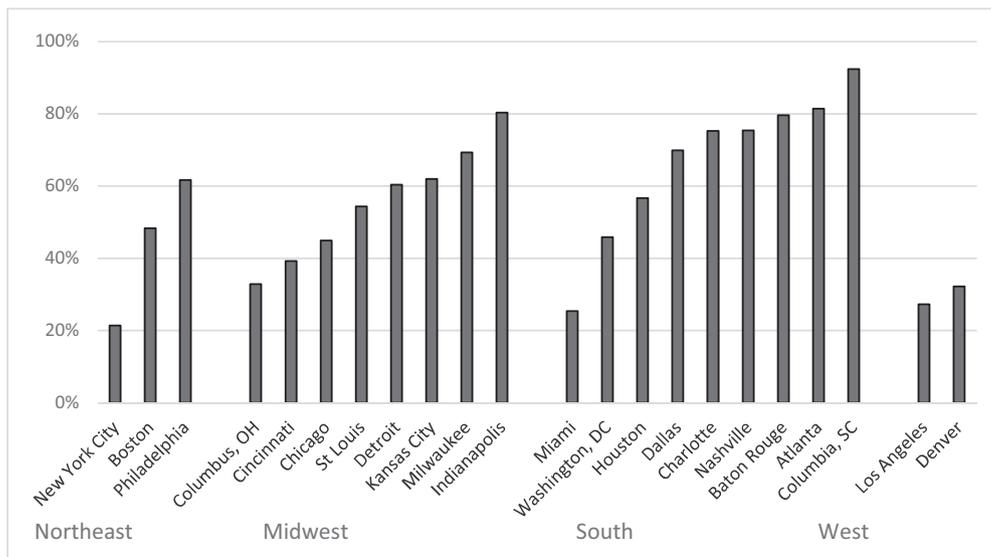


Fig. 2. Percent of pediatric umbilical hernia repair patients with filled opioid prescriptions, by metropolitan statistical area.

**Table 3**  
Opioid medications by patient age.

Age (years)	Codeine/APAP* (%)	Hydrocodone/ APAP (%)	Oxycodone (%)	Oxycodone/APAP (%)	Tramadol (%)	P value
0–1	34 (34.7)	49 (50)	11 (11.2)	1 (1)	3 (3.1)	.002
2–3	113 (28.5)	211 (53.2)	50 (12.6)	22 (5.5)	1 (0.3)	
4–5	255 (31.5)	405 (50)	118 (14.6)	27 (3.3)	5 (0.6)	
6 or older	284 (29.5)	493 (51.1)	106 (11.0)	69 (7.2)	12 (1.2)	
Total	686 (30.2)	1158 (51)	285 (12.6)	119 (5.2)	21 (0.9)	

\* Acetyl-para-aminophenol, also known as acetaminophen.

**Table 4**  
Days' supply of opioid medications by age.

Age (years)	1–3 days (%)	4–10 days (%)	More than 10 days (%)	P value
0–1	41 (41.8)	51 (52)	6 (6.1)	.382
2–3	191 (48.1)	186 (46.9)	20 (5)	
4–5	412 (50.9)	368 (45.4)	30 (3.7)	
6 or older	484 (50.2)	449 (46.6)	31 (3.2)	
Total	1,128 (49.6)	1,054 (46.4)	87 (3.8)	

**Table 5**  
Patients filling a second opioid prescription within 30 days.

Age (years)	Opioid fills	Second fills		P value
		Number	%	
0–1	98	7	7.1	.040
2–3	397	16	4	
4–5	810	40	4.9	
6 or older	964	72	7.5	
Total	2,269	135	6.0	

common medications prescribed were hydrocodone with APAP (51%), codeine with APAP (30%), and oxycodone with APAP (13%). Children 1 year of age or younger were prescribed codeine and tramadol more often than older age groups. The rate of codeine use declined significantly over time ( $P < .001$ ), from 49% of fills in 2012 to 18% in 2015, after the FDA issued a warning about the use of codeine in pediatric patients.

The number of days' supply of opioid medications varied by age, but not significantly (Table 4). Very young children under the age of 1 year were less likely to be given a small prescription (1–3 days' supply) than were older children. The percentage receiving an opioid prescription for 10 days' supply or more was low and declined steadily with age, from 6% for children 1 year of age or younger to 3% for children 6 years of age or older.

Of the postrepair patients with a filled prescription for opioids, 6% filled a second prescription within 30 days of the hernia repair (Table 5). A small percentage of patients (0.8%) filled second opioid prescriptions on the same day as the first opioid. The rates varied significantly by age. Second prescriptions were more common for very young children (0–1 years of age) and older children (6 years of age or older). We tested whether shorter duration initial prescriptions were associated with having a second prescription fill, but no significant relationship was found (*data not shown*).

## Discussion

We found that approximately half (52%) of pediatric patients filled a prescription for opioids after uncomplicated umbilical hernia repair, which is a simple procedure with minimal tissue disruption, for which an American College of Surgeons patient information guide<sup>26</sup> states that parents should expect their children to return home with only non-narcotic pain relief. There was wide geographic variation in the rate of prescribing, both by census region and metropolitan area. This variability suggests that beyond individual prescribing differences attributable to training or habit, differences in local or institutional norms and local variation in the expectations of patients' families may be factors in whether opi-

oids are prescribed after minor surgery. Although a relatively small percentage of patients (6%) received a second opioid fill, prescription refills are unlikely to be needed for postoperative pain after this minor procedure. This is suggestive of possible chronic opioid use disorders, at a rate similar to that described for adults<sup>19</sup> and older children.<sup>9</sup>

These results suggest that excessive amounts of opioids are being prescribed to some children, and a change in prescribing habits could improve care. Raney et al<sup>27</sup> describe the lack of consensus among orthopedic surgeons regarding the appropriate opioid medication, dose, and prescription length for common pediatric procedures. Our findings and the variation in prescribing described in the literature suggest that this lack of consensus exists beyond orthopedics. Efforts are being made by the Michigan Opioid Engagement Network to develop and implement local guidelines for appropriate opioid prescribing with success.<sup>3</sup> National consensus guidelines from the American Pain Society for the management of postoperative pain<sup>28</sup> do not address standardization of prescribing but do include the use of nonopioid medications and nonpharmacologic modalities and suggest that patients can be discharged with only nonopioid analgesics after minor surgery.

Although research has found a trend toward less opioid prescribing over time,<sup>2,4</sup> our results are not as clear. We found that the rate of prescribing opioids for umbilical hernia repair significantly increased in the years 2012–2014, with a modest decline in 2015. The median number of days' supply (4 days) did not change over the period studied, and the IQR for 2012–2014 was 3–5 days. In 2015, the IQR was 2–5 days, indicating that more prescribers were giving small prescriptions. The study dates precede the most recent public policy focus on the opioid epidemic, which may have led to more recent changes in prescribing practices.

Our results on opioid prescribing by patient age are similar to those described by Van Cleve and Grigg for the period 2007–2012.<sup>15</sup> We found that three main opioid medications were prescribed to children after this outpatient procedure—codeine with APAP, hydrocodone with APAP, and oxycodone with APAP—with small percentages filling prescriptions for oxycodone or tramadol. We also found that the most common medication prescribed varied with age, with younger children more likely to be prescribed codeine and tramadol and older children more likely to receive hydrocodone. As the rate of codeine prescribing declined over time 2012–2015, the rate of hydrocodone prescribing rose, perhaps because prescribers were avoiding codeine in response to the FDA black box warning on codeine for pediatric tonsil and adenoid resection released in 2012.<sup>29</sup> As an important reminder that even regulatory intervention has limited influence on prescription behavior, use of codeine for pediatric tonsillectomy and adenoidectomy declined but was not eliminated after this warning.<sup>30</sup>

This study has several limitations. The data set includes only patients with employer-paid private insurance, not Medicaid or other public payers, and is a convenience sample with wide variation in geographic coverage. This limits the generalizability of our findings, particularly our comparisons of granular geographic regions. To mitigate this effect, we compared only MSAs with more than 50 procedures in the study period but could still be inaccurately estimating variation in these communities. Pharmacy data

are only available for a subset of cases (89%) and contain only filled opioid prescriptions. These data therefore may not accurately describe either prescribing or consumption patterns. Also, our data do not include patient weights, which would have permitted us to calculate dosing for children. Instead, we analyzed the number of days' supply, which is an indirect measure of the prescribed dose.

Our study found variation in opioid prescription practices for pediatric umbilical hernia repair. Notably, half of postsurgical patients did not require any opioids. Such variation for a relatively standardized, minimally disruptive surgical procedure suggests that best practice guidelines could be developed and disseminated to reduce opioid prescriptions for this and similar procedures. Dissemination of such guidelines, in addition to personalized benchmarks of prescribing practice, could inform and encourage prescribing surgeons to minimize use of opioids, thereby improving the quality of care for children. Using data on variability in opioid prescriptions, such as that described in this report, to encourage surgeons to reduce opioid prescribing after surgery is a core project of several surgical collaboratives, including the Surgical Collaborative of Wisconsin, of which the authors are members. Data-driven collaborative efforts by surgeons—the leading prescribers of opioids to opioid-naïve patients—have the potential to be a major factor in reducing the oversupply of opioids in the community and ameliorating the epidemic of opioid abuse in the United States.

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