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Unused opioid prescription prevalence after pediatric ambulatory surgery: a survey study

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Abstract

Background: Surgery is a risk factor for opioid initiation, persistent use, and subsequent misuse in pediatric patients. The objective of this study was to assess the rate of postoperative opioid prescribing and extent of unused opioid prescriptions on the first postoperative day after pediatric ambulatory surgery.

Methods: A telephone survey was administered on postoperative day 1 (POD1) to guardians of all pediatric patients who underwent ambulatory surgery at a single medical center. Participants were asked whether postoperative opioids were prescribed, and, if yes, whether they were currently taking them. Multivariable logistic regression was used to assess factors associated with postoperative opioid prescribing and unused opioids on POD1.

Results: Of 1344 pediatric patients who underwent ambulatory surgical procedures, 849 (63.1%) guardians responded to the survey. 275 (32.4%) were prescribed postoperative opioids, and 164 (59.6%) reported not taking opioids on POD1. The highest rates of unused opioid prescriptions were from orthopedic and plastic surgery services (28% and 29%, respectively). Governmental insurance status predicted having unused opioids (OR 0.59, CI 0.35–0.97).

Conclusions: Unused opioid prescriptions were prevalent in this pediatric ambulatory surgical population. Opportunities remain to streamline opioid prescribing in pediatric patients undergoing ambulatory surgical procedures.

Keywords: Pediatric surgery, Postoperative pain, Opioid, Over-prescription

Highlights

- Surgery is a risk factor for opioid abuse in the pediatric population.
- Current opioid prescribing after pediatric ambulatory surgery is varied and often non-evidence-based.
- 59.6% of pediatric patients undergoing ambulatory surgery who are prescribed opioids do not use those prescribed opioids on postoperative day 1.
- This finding presents an opportunity to decrease opioid exposure by further streamlining opioid prescribing in pediatric surgical patients.

Background

The opioid epidemic in the USA and its widespread health, cultural, and economic implications have been well described. While the opioid epidemic is less studied in children than adults, evidence from the past two decades shows that hospitalizations in pediatric age groups attributable to opioid overdose have continued to rise, with adolescents being particularly vulnerable [1]. After exposure to opioids in a medical context, adolescents are more likely than to use opioids recreationally, share them with friends, and develop drug dependence and

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abuse disorders later in life [2–4]. Furthermore, surgery is a known risk factor for opioid exposure and persistent use [5, 6], with 6–10% of opioid-naïve adults continuing to use opioids for over 3 months, and sometimes for over a year, following minor and major surgery [7, 8]. Approximately 5% of pediatric patients continue to fill opioid prescriptions 2 to 6 months after surgeries like cholecystectomy, arthroscopic knee repair, colectomy, and wisdom tooth extraction [9, 10].

One strategy to decrease exposure to opioids is to ensure patients are prescribed only the number of opioid pills they are expected to use after any particular surgery. Unfortunately, there is wide variability in opioid prescribing practices, and prescribing patterns are often based on surgical service culture rather than evidence-based practice [11–13]. For example, a study in pediatric patients undergoing tonsillectomy and hernia repair found wide variability in discharge opioid prescribing, with children receiving between 2 to 26 days of opioids following these procedures [14], a finding that has been replicated in nationwide samples [15].

To date, individual surgical departments have reported implementation of educational interventions or enhanced recovery protocols to reduce opioid prescription for specific pediatric surgeries [16, 17]. Further, some have recommended eliminating discharge opioid prescription for pediatric patients undergoing surgeries like herniorrhaphy, appendectomy, and adenoidectomy, which are usually associated with minimal pain and postoperative opioid use [18]. To determine whether opioid-prescribing practices at a pediatric tertiary care hospital reflect current recommendations, we evaluated postoperative opioid-prescribing practices and the extent of unused opioid prescriptions in pediatric patients who have undergone ambulatory surgery.

Methods

This study was approved by the University of California, San Francisco Institutional Review Board, protocol 18-25689, with a waiver of informed consent because it used existing data collected during a quality improvement initiative.

Data sources and study cohort

A telephone survey evaluating opioid use on postoperative day (POD) 1 was conducted for all patients \leq 21 years of age who underwent ambulatory surgery at a pediatric tertiary-care hospital. Ambulatory surgery in this context was defined as an operative procedure from which patients were discharged home directly from the post-anesthesia care unit or who remained in the hospital less than 23 h.

The telephone survey was administered on the day after discharge to all ambulatory surgical patients and consisted of an automated phone call with questions posed to the patient or the patient's caregiver.

During the study period of April 2017 to December 2017 all ambulatory surgical patients or listed guardians were called on POD 1 and asked:

Question 1: Were you prescribed opioids for postoperative pain control? Examples of opioids include Norco, Vicodin, Percocet, oxycodone, or Dilaudid.

Question 2: (only asked if patients answered “yes” to Question 1) If yes, are you currently taking them?

For our survey, responders were those who answered at least Question 1; non-responders did not answer either question. Demographic and surgical case characteristics were obtained from patients' electronic health and linked to survey answers.

All patients who underwent ambulatory surgery were included in the cohort and were then divided into responders versus non-responders (see Supplementary Table 1). Of the responders, this study focuses on outcomes of those that were prescribed opioids post-surgery.

Outcomes

Our primary outcome of interest was receipt of an opioid prescription, defined as answering “yes” to Question 1. Our secondary outcome was unused opioid prescription, defined as answering “yes” to Question 1 and “no” to Question 2. In other words, responses that postoperative opioids were prescribed but were not being used on POD 1.

We looked at potential risk factors of postoperative opioid prescription and unused opioid prescription including age, gender, American Society of Anesthesiologists physical status rating (ASA status) as a proxy for severity of illness, insurance status (private or governmental), surgical case length in minutes, and distance between patient residence and our medical center. We further stratified results by surgical service.

Finally, for patients who were prescribed opioids, we investigated average, and range of oral morphine equivalents (OMEs) prescribed per kilogram bodyweight [16], and OMEs converted to days of opioid prescribed based on prescription instructions.

Statistical analysis

Univariable analyses were conducted using chi-square, Fisher's exact, Kruskal-Wallis, and Student's *t* tests as appropriate. Kruskal-Wallis was used to evaluate non-parametric ranked data. Next, a binomial logistic regression model was created to identify predictors of opioid prescription and unused opioid prescription. We included variables in models if they were potential

confounders regardless of differences in baseline statistics. All analyses were performed using STATA 15.1 (StataCorp LP, TX, USA).

Results

Of the 1344 pediatric patients who underwent ambulatory surgery during the study period, 849 (63.1%) responded. Characteristics of responders are presented in Supplementary Table 1. On average, responses were more likely if the patient undergoing surgery was > 2 years of age and had private insurance; otherwise, responders did not differ from non-responders. Approximately 60%

of survey responses were for male patients, 55% were for those aged 2–12 years, and 90% were for patients rated ASA 1 or 2 (Table 1). The average surgical length was approximately 1 h.

275 patients were prescribed opioids on discharge (32.4%). Of those prescribed postoperative opioids, 164 (59.6%) reported not using them on POD 1. Unused opioid prescribing occurred across surgical services (Fig. 1), ranging from rates of 3–4% (dentistry and ophthalmology) to 28–29% (orthopedic and plastic surgery). Notably, the neurosurgery service discharged 55% of its patients with opioids, and all patients reported using them on

Table 1 Characteristics of the study population and of patients prescribed and not using opioids

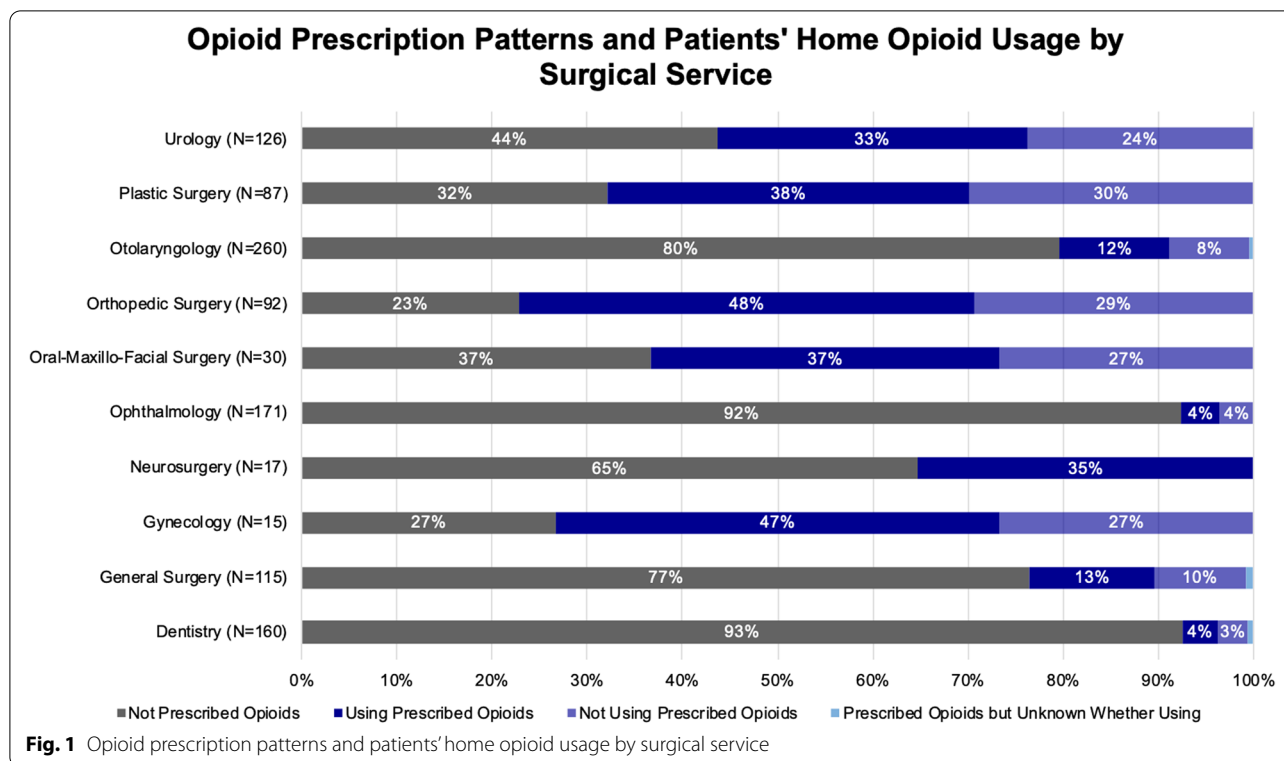
	All responders	Prescribed discharge opioids	Not prescribed discharge opioids		Taking opioids on POD 1	Not taking opioids on POD 1	
	N (%)	N (%)	N (%)	P value	N (%) ^a	N (%)	P value
All	849 (100.0%)	275(32.4% of total)	574(67.6% of total)		164(59.6% of pre-scribed)	109(39.6% of pre-scribed)	
Gender				0.97			0.6
Female	342 (40.3%)	111 (40.4%)	231 (40.2%)		64 (39.0%)	46 (42.2%)	
Male	507 (59.7%)	164 (59.6%)	343 (59.8%)		100 (61.0%)	63 (57.8%)	
Age, mean ± SD, years	7.6 ± 6.3	11.1 ± 7.0	5.9 ± 5.1	< 0.001*	11.3 ± 7.2	10.8 ± 6.7	0.6
Age groups				< 0.001*			0.09
Infants (0–2 years old)	152 (17.9%)	43 (15.6%)	109 (19.0%)		27 (16.5%)	16 (14.7%)	
Children (2–12 years old)	463 (54.5%)	87 (31.6%)	376 (65.5%)		44 (26.8%)	43 (39.4%)	
Adolescents (12–21 years old)	234 (27.6%)	145 (52.7%)	89 (15.5%)		93 (56.7%)	50 (45.9%)	
Case length in minutes, mean ± SD	61.4 ± 54.2	78.2 ± 61.0	53.3 ± 48.7	< 0.001*	81.5 ± 58.3	71.8 ± 62.6	0.19
Type of Insurance				0.04*			0.04*
Private	423 (49.8%)	151 (54.9%)	272 (47.4%)		81 (49.4%)	68 (62.4%)	
Public (government-sponsored) ^b	426 (50.2%)	124 (45.1%)	302 (52.6%)		83 (50.6%)	41 (37.6%)	
ASA status				0.21			0.3
ASA 1	337 (39.7%)	123 (44.7%)	214 (37.3%)		79 (48.2%)	44 (40.4%)	
ASA 2	431 (50.8%)	130 (47.3%)	301 (52.4%)		75 (45.7%)	54 (49.5)	
ASA 3	77 (9.1%)	21 (7.6%)	56 (9.8%)		9 (5.5%)	11 (10.1%)	
ASA 4	3 (0.4%)	1 (0.4%)	2 (0.3%)		1 (0.6%)	0	
Distance from hospital				0.03*			0.1
San Francisco (local)	181 (21.3%)	52 (18.9%)	129 (22.5%)		34 (20.7%)	17 (15.6%)	
Within 2 h driving outside of SF	422 (49.7%)	155 (56.4%)	267 (46.5%)		84 (51.2%)	70 (64.2%)	
> 2 h driving of SF	246 (29.0%)	68 (24.7%)	178 (31.0%)		46 (28.0%)	22 (20.2%)	

Abbreviations: ASA Rating American Society of Anesthesiologists physical status rating, POD postoperative day

^a 2 patients did not respond to Question 2

^b Government-sponsored insurance included Medicaid, Medicare, Covered California, and California Children's Services

*Significant at p<0.05 level



POD 1. Contrastingly, the gynecology, oral and maxillofacial surgery, orthopedic surgery, and plastic surgery services all discharged at least 60% of their patients with opioids; 33 to 42% of those patients reported not using opioids on POD 1.

The number of days of opioids prescribed and total OMEs per kilogram varied substantially by procedure type and across patients (Fig. 2a). For example, most children undergoing tonsillectomy and adenoidectomy were discharged with a 3- to 7-day opioid prescription, but one patient received a > 15-day supply of opioids. Most patients who underwent orchiopexy or orchiectomy received 2 to 4 days of opioids, but some received up to a 10-day supply. These findings are also illustrated in oral morphine equivalents per kilogram in Fig. 2b.

Older patients, as well as those who had private insurance, underwent longer surgeries, or lived further from the medical center were significantly more likely to be prescribed opioids.

Age and longer case length remained significant in multivariable analysis (see Table 2), showing increased odds of being prescribed opioids with age (OR 1.15 per year of age, CI 1.12–1.17) or longer case length (OR 1.01 per minute, CI 1.00–1.01). Insurance status also remained significant in multivariable analysis, with those having government-sponsored insurance significantly less likely to be prescribed opioids (OR 0.72, CI 0.52–0.99).

Patients with government-sponsored insurance were also significantly less likely to be using opioids compared to privately insured patients (OR 0.59, CI 0.35–0.97), as shown in Table 2. No other variables were significantly associated with unused opioid prescription.

Discussion

Our demonstrates significant variability in the rate of opioid prescribing by surgical subspecialty, as well as variability in the amount of opioid prescribed per patient. This results corroborates previous documentation that even at a single institution postoperative analgesic prescriptions vary widely. Inconsistency in opioid prescription across surgical services and for specific procedure types may be multifactorial in etiology. While differences in types of surgeries and underlying pathologies can lead to varied degrees of postoperative pain, surgical prescribing culture may also drive these findings [19]. Surgical services may currently determine their discharge opioid prescription practices based on convention rather than evidence or protocols, as supported by a study showing disparate discharge opioid prescriptions in laparoscopic appendectomies on adolescents performed by adult versus pediatric general surgeons at the same institution [20].

Most pediatric surgeries performed in the USA are ambulatory and, by design, are expected to result in minimal and manageable postoperative pain [21]. Despite

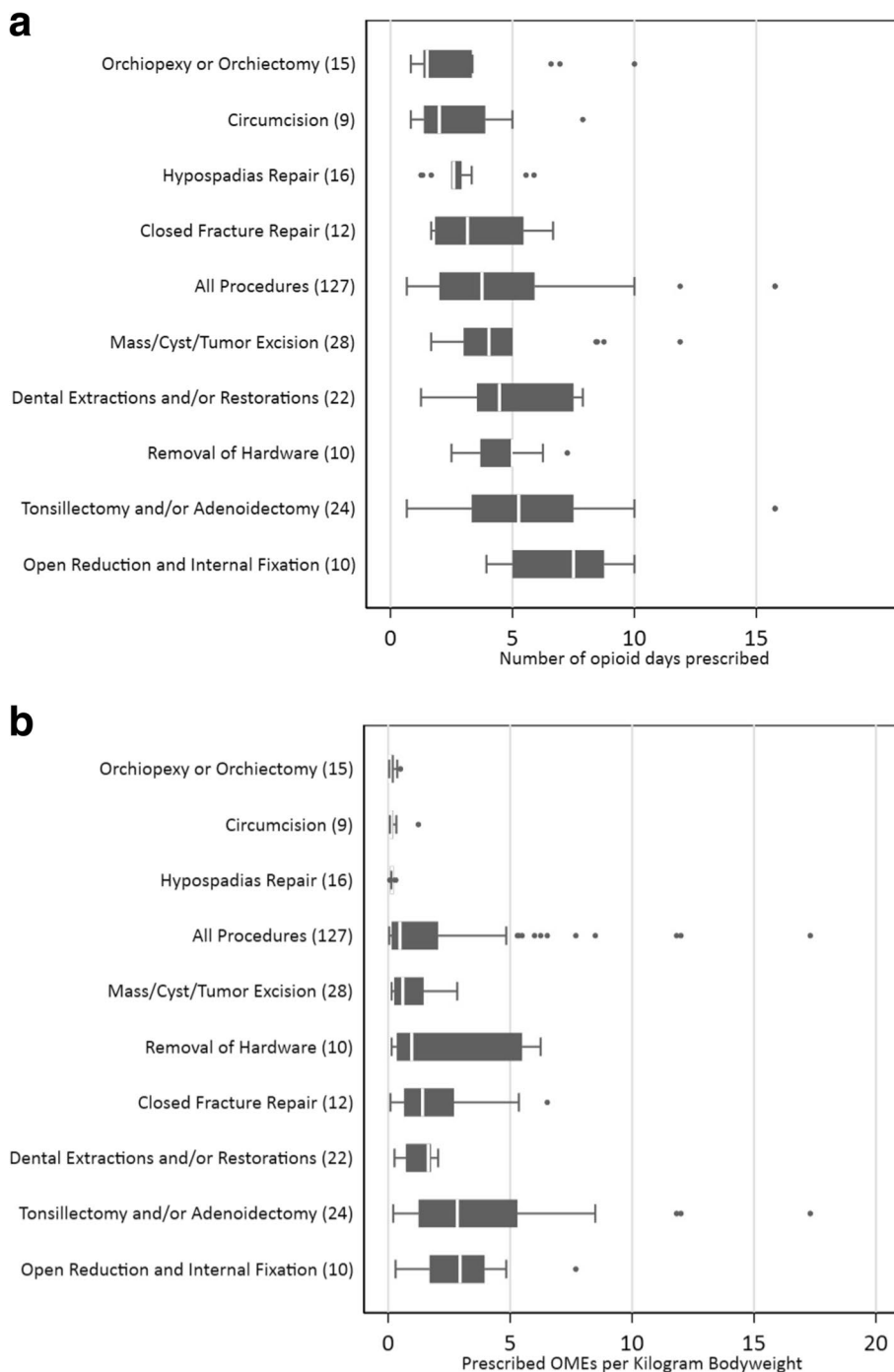


Fig. 2 **a** Days of opioids prescribed by procedure type. **b** Prescribed OMEs per kilogram bodyweight by procedure type

this, surgeons may overprescribe opioids because they are concerned about adequate postoperative analgesia or because there are currently no standard guidelines for appropriate analgesic dosing regimens for pediatric patients. Some institutions have started publishing evidence-based, procedure-specific guidelines for adult

surgical patients, but these have not yet been widely disseminated for pediatric populations [22].

Pediatric discharge prescribing could be optimized by establishing procedure-specific opioid and non-opioid regimens, considering whether opioids are necessary for some surgeries or for some patients, and ensuring

Table 2 Adjusted odds of opioid prescription and unused opioids

Variable	Odds of opioid prescription			Odds of unused opioid prescription		
	OR	95% CI	P value	OR	95% CI	P value
Gender (ref=female)	0.87	(0.63–1.21)	0.43	1.12	(0.66–1.89)	0.67
Age	1.15	(1.12–1.17)	<0.001*	0.99	(0.96–1.03)	0.70
Insurance status (ref=private)						
Government-sponsored ^a	0.72	(0.52–0.99)	0.05*	0.59	(0.35–0.97)	0.04*
ASA status (ref=ASA 1)						
ASA 2	0.62	(0.45–0.89)	< 0.001*	1.36	(0.80–2.30)	0.25
ASA 3	0.46	(0.25–0.85)	0.01*	2.43	(0.89–6.66)	0.08
ASA 4	0.46	(0.01–14.0)	0.65	N/A	N/A	N/A
Case length in minutes	1.01	(1.00–1.01)	< 0.001*	1.00	(0.96–1.03)	0.70
Distance from hospital (ref=SF local)						
Within 2 h of San Francisco (compared to SF-local)	1.40	(0.92–2.13)	0.11	1.47	(0.74–2.91)	0.27
> 2 h from San Francisco	0.85	(0.52–1.37)	0.5	0.85	(0.37–1.94)	0.70
Constant	0.16	(0.1–0.3)	< 0.001*	0.70	(0.31–1.57)	0.39

Abbreviations: ASA Status American Society of Anesthesiologists physical status rating, POD postoperative day, OR odds ratio, CI confidence interval

^a Government-sponsored insurance included Medicaid, Medicare, Covered California, and California Children's Services

*Significant at $p < 0.05$

adequate dosing of analgesics to avoid uncontrolled postoperative pain. Our study supports the need to closely evaluate and tailor postoperative pain medication regimens by surgery type as part of a multi-pronged approach [23] to optimize opioid stewardship as well as postsurgical analgesia and safety for pediatric patients. "Raising provider awareness, educating patients on expected postoperative pain management options, and prioritizing non-narcotic medications postoperatively successfully reduced opioid prescription rates in children undergoing skin and soft tissue lesion excisions and simultaneously improved patient-satisfaction scores."

Our study highlights an important contributor to the opioid epidemic in the pediatric population. While the overall rate of postoperative opioid prescriptions was low for pediatric ambulatory surgery patients; among those who received opioids, the rate of unused opioids was still high. We observed this trend across many different specialties and procedures, highlighting a concerning pattern of postoperative opioid overprescription. Thus, despite awareness of the risks of opioids in children and adolescents, postoperative opioid prescribing leading to a reservoir of unused opioid medication in the community still occurred in pediatric ambulatory surgery patients.

Surgeons in our study were also more likely to prescribe opioids to older children, those who underwent longer surgeries, and those who lived further away from the hospital. Older age remained a clinically significant predictor of opioid prescription in multivariable analysis.

While national organizations recommend judicious use of opioids in infants, they also endorse conservative opioid prescription in older children and adolescents [23]. Adolescents with no prior history of drug use are particularly at risk for future opioid dependence or misuse, theoretically because the exposure to postoperative opioids in a legitimized and controlled setting may downplay its potential risks [3]. Adolescent neurodevelopment in executive function and inhibitory control is not fully mature and may also contribute to these patients' initial risk-taking behavior with prescribed opioids, which may then develop into dependence and future misuse [24].

While longer case length and distance from the hospital did were not significant predictors of opioid prescription in multivariable analysis, these factors may still be important considerations in surgeons' prescribing decisions. Surgeons may anticipate more pain after longer surgeries and may therefore be more likely to prescribe opioids on discharge [8]. They may also be concerned about inadequate analgesia in patients who live further away and have difficulty returning to the hospital for assessment or a prescription. Importantly, however, case length and distance from the hospital were not significant predictors of using opioids in our analyses, and therefore may not be useful considerations when prescribing postoperative medications.

Surgeons were less likely to prescribe opioids to patients with governmental insurance than those with private insurance, and those with governmental insurance who were prescribed opioids were less likely to use

them. Children receiving insurance benefits through governmental programs such as Medicaid are disproportionately children of color and—by virtue of their enrollment—are economically disadvantaged [25]. Our dataset did not include information about race/ethnicity, cultural background, socioeconomic status, or primary language and therefore does not provide insight into the underlying drivers of these findings; future research should investigate further to understand these disparities in both prescription and use of opioids.

Limitations

This study was based on a telephone survey, which by nature is dependent on self-report and subject to recall bias and participants' subjective interpretation. We corroborated patients' responses to the first question of the survey by identifying discharge opioid prescriptions in our electronic medical records; approximately 9% of patients who reported being prescribed an opioid did not have a recorded discharge opioid prescription. These patients may have filled the opioid prescription in advance of the procedure instead of on the day of discharge, or they may have used opioids available through other means at home; however, this suggests that our unused opioid prescription rate may be overestimated. Our study was conducted at a single academic hospital in San Francisco, and findings may therefore not be generalizable to all hospitals in the USA, particularly private hospitals or those in less urban settings. Our dataset did not include information on race/ethnicity, specific medical comorbidities, or prescription of non-opioid adjuncts, all of which may influence opioid prescription and/or need after surgery. Finally, it is possible that there have been changes in prescription patterns, postoperative medication compliance, and insurance status since the time this study was initially conducted. Despite these limitations, our findings show that opioids are being prescribed at a rate and amount that is often higher than patients' use, offering an opportunity for optimizing postoperative opioid prescription patterns in pediatric ambulatory surgery patients.

Conclusions

Many opioid prescriptions are unused following pediatric ambulatory surgery at our institution. This warrants further investigation by surgical prescribers and the perioperative team because of the potential contribution of unused postoperative opioid prescriptions to the U.S. opioid epidemic, particularly in vulnerable pediatric populations.

Abbreviations

ASA status: American Society of Anesthesiologists physical status rating; OMEs: Oral morphine equivalents; POD: Postoperative day; OR: Odds ratio; CI: Confidence interval.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s43159-022-00219-7>.

Additional file 1: Supplementary Table 1. Characteristics of survey responders and non-responders

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Authors' contributions

Dixit: study conception and design, literature search, data retrieval, data analysis, data interpretation, and manuscript writing. Ho: data analysis, data interpretation, and manuscript writing. Inglis-Arkell: study conception and design, data retrieval, and critical revision. Chen: data interpretation, critical revision. Ferschl: data interpretation, critical revision. Manuel: study conception and design, data retrieval, data analysis, data interpretation, manuscript writing, and critical revision. All authors read and approved the final manuscript.

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Availability of data and materials

The data that support the findings of this study are available on request from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This study was approved by the University of California, San Francisco Institutional Review Board, protocol 18-25689.

Consent for publication

Not applicable. This manuscript does not contain identifiable data from any individual person.

Competing interests

The authors declare that they have no competing interests.

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