Characteristics of opioid prescriptions for discharged pediatric emergency department patients with acute injuries

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ABSTRACT

This study describes the characteristics of opioid prescriptions for pediatric patients discharged from the emergency department (ED) with acute injuries, including type, formulation, quantity dispensed, and associations with patient age group and prescriber level of training. This retrospective cohort study enrolled all acutely injured patients receiving opioid prescriptions at discharge from an urban academic pediatric ED in a 1-year period. Electronic medical records were reviewed to abstract clinical and prescription data and prescriber level of training. Descriptive statistics were used for analysis. We identified 254 patients with injuries who received opioid prescriptions at ED discharge during the study period (mean age 9.5 years, 65% male). The most common injury was fracture (71%). Oxycodone was the opioid most frequently prescribed (96.1%). Liquid formulations were prescribed in 51.6% of cases. The median number of doses prescribed per prescription was 12 (SD±9.1), with a range of 1–50. Residents wrote 72.9% of prescriptions and prescribed more doses than non-residents (15.5 vs 12.2, p=0.01). Post-graduate year 2 (PGY2) residents prescribed more doses than PGY1 or PGY3+ residents. Our data show wide variation in the number of opioid doses prescribed to acutely injured pediatric patients at ED discharge and frequent use of liquid formulation; both factors may place this population at risk for accidental ingestion. These findings also support the development of pediatric clinical guidelines to define appropriate quantities of opioids to prescribe, promote poisoning prevention strategies, and design post-graduate education for medical trainees about safe prescribing practices.

INTRODUCTION

Although opioids have an important role in pain control, opioid abuse and poisoning are a national epidemic with an increasing pediatric component. The Centers for Disease Control and Prevention reported an overall upward trend of deaths involving opioids, and this trend includes commonly prescribed opioids.[1] Poison center data have shown that the number of children visiting emergency departments (EDs) after medication exposure is increasing.[2] Nearly 5000 children less than 6 years of age visit the ED annually for opioid exposures.[3 4] In a study investigating childhood ingestion of methadone and buprenorphine from 1999 to 2009, the prevalence of ingestion increased over three times between the first and last 5 years of study.[5] From 2000 to 2009, the overall numbers of opioid exposures increased significantly by 86%.[6] From 2002 to 2012, >22,000 children were treated in US EDs for opioid poisoning.[6 7] From 1999 to 2012, 8986 children died from prescription and illicit opioid poisonings.[3] Studies have described increasing rates of opioid prescriptions in adults are paralleled by increasing rates of exposures in children[8] and an increase in calls to poison centers regarding pediatric exposure to opioids as they are more available in outpatient pharmacies.[9]

Despite these concerning trends, there are no current pediatric guidelines to assist providers with opioid dosing, including total quantity to be dispensed. Although some guidelines exist for managing adults with chronic pain,[10] these data are not easily translated to the care of children with acute injuries. Additionally, data about pediatric opioid prescribing practices for acute injuries are sparse. There is limited data about prescribing practices of analgesia after pediatric ambulatory surgery,[11] and one study of pediatric opioid prescribing from inpatient units shows widely variable dosing.[12] There are few published studies that describe the prescribing trends of pediatric trainees. In one study, odds of receiving an opioid prescription for more than 5 days' duration were higher if the prescription was written by a resident physician.[13]

The increase in exposures to opioids in the pediatric population and the absence of robust data about prescribing practices are concerning for pediatric opioid prescribers. To address this gap, the primary aim of this study is to describe the characteristics of opioid prescriptions for pediatric patients discharged from the ED with acute injuries. The secondary aim is to describe prescribing trends in trainees, specifically residents, versus those who have completed medical training.

MATERIALS AND METHODS

This study is a retrospective cohort study conducted at an urban academic pediatric ED in Baltimore, Maryland. This ED is an American College of Surgeons certified level 1 trauma center with an estimated annual census of 35,000 patients. The study time period was January 1, 2013 to December 30, 2013. A query of the electronic health record identified all prescriptions written during the time period. Prescriptions were excluded if they were written for non-controlled substances or for non-opioids. The records of patients receiving opioid prescriptions at discharge for an acute injury were eligible for enrollment in the study and identified through review of the charts associated with opioid prescriptions. Acute injury was defined as having a clearly defined onset, causing pain lasting less than 3 months, and not associated with a chronic pain condition, such as sickle cell disease or cancer. Prescriptions were excluded if there were multiple prescriptions per encounter, because it could not be determined which prescription was provided to the patient.

For eligible patients, electronic medical records were reviewed in detail to abstract clinical, prescription, and prescriber data. Clinical data included patient age in years, gender, race, chief complaint, and primary diagnosis at discharge. Prescription data included medication prescribed, total doses per prescription, and formulation (tablet vs liquid). For prescriptions in which the patient was prescribed to take 1–2 tablets per dose, for example, we calculated the number of doses for taking one tablet per dose. Prescriber data included training status (resident or non-resident, which included attending, fellow or midlevel provider) and training year for resident providers. Prescriptions written by medical students during their subinternships were coded as 'non-resident,' since they would need to be directly reviewed and cosigned by an attending physician. Data were entered in Microsoft Excel for Mac 2011 (Microsoft Corporation, Redmond, Washington) and analyzed by using SPSS Statistics V.23.0. Descriptive statistics were used to analyze prescription data. The hospital institutional review board approved this study.

RESULTS

We initially identified 17,879 prescriptions written during the study period. Seven hundred and ninety-seven prescriptions were written for controlled substances, of which 697 prescriptions were written for opioids (3.9% of total prescriptions). Two hundred and ninety-three prescriptions were excluded for being written for a chronic pain condition. One hundred and seventeen prescriptions were excluded for being prescribed for non-injuries. After 29 duplicate prescriptions were removed, 258 opioid prescriptions written for 254 patients were included in the final analysis. Two prescriptions were included for patients with chronic pain conditions: one for an acute back sprain in a child with chronic back pain and one for a traumatic hand injury in a patient with sickle cell disease.

Characteristics of the study population, prescriptions written, and prescribers are presented in table 1.

Patients' ages ranged from 0.4 to 23 years. Prescriptions were most commonly written for fractures (n=184, 71.3%), burns (n=21, 8.1%), and lacerations (n=12, 4.6%).

Table 1 Summary of study population, prescription, and prescriber data

Study population characteristics	
Gender (proportion female)	88/254* (34.6%)
Mean age	9.5 years (SD±5.2)
Proportion of patients in each racial group	
African American	118/254 (46.4%)
White/Caucasian	105/254 (41.3%)
Other	31/254 (12.2%)
Prescription characteristics	
Opioid prescribed (n, % of total)	
Oxycodone	248 (96.1%)
Hydromorphone	2 (0.8%)
Morphine	1 (0.4%)
Tramadol	1 (0.4%)
Combination product	6 (2.3%)
Number per age group (n, % of total)	
All ages	258
0–2 years	35 (13.6%)
3–6 years	44 (17%)
7–12 years	98 (38%)
>12 years	81 (31.4%)
Doses per prescription (mean±SD)	
All ages	14.7±9.1
0–2 years	14.0±7
3–6 years	14.0±8.3
7–12 years	16.7±10.8
>12 years	13.0±7.5
Number of liquid formulation (n, % of total)	
All ages	133, 51.6%
0–2 years	34, 97.1%
3–6 years	43, 97.7%
7–12 years	51, 52%
>12 years	5, 6.2%
Prescription error	3, 1.2%
Prescriber characteristics	
Number of prescriptions per prescriber group	
Resident	189
PGY1	71
PGY2	70
PGY3+	48
Non-resident	69
Number of doses per prescription (mean±SD)	
Resident	15.6±9.5†
PGY1	13.9±8.3
PGY2	18.4±11.6
PGY3+	14.0±6.8
Non-resident	12.2±7.4†

*Four patients received more than one prescription during the study period.
†Residents were found to prescribe a larger number of doses than non-resident (p=0.01).
PGY, post-graduate year.

The most commonly prescribed opioid was oxycodone (n=248, 96.1%). Six prescriptions were for combination products (2.4%): acetaminophen with codeine (n=3), acetaminophen with oxycodone (n=2), and acetaminophen with hydrocodone (n=1). Liquid formulation was written

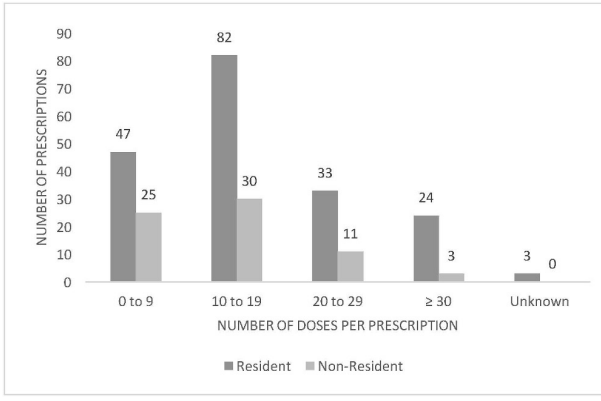

Figure 1 Number of doses prescribed per prescription.

in 133 prescriptions (51.6%), tablets or capsules were ordered in 113 prescriptions (43.7%), and not specified in 12 prescriptions (4.7%).

The number of doses ranged from 0 to 50 doses per prescription (see figure 1). The median number of doses was 12 per prescription. The number of doses was not calculated in three prescriptions. All of these three prescriptions were written to dispense 'one bottle' of medication without a specific volume to be dispensed. There was no statistical difference in the number of doses prescribed per age group.

Prescriptions were grouped by provider characteristics: resident versus non-resident and post-graduate year (PGY) for residents. Residents include both pediatric and non-pediatric residents (most commonly general emergency medicine (GEM) residents). Resident training program was not included in the analysis to protect prescriber anonymity, as fewer GEM residents than pediatric residents are assigned the pediatric ED clinical rotation. Non-residents include faculty (MD, DO), clinical associates (MD, CRNP, PA), and medical students. Given the small number of advanced practice practitioners at our institution, non-residents were not subgrouped into categories to protect prescriber anonymity. Overall, residents were found to prescribe a larger number of doses than non-residents (mean doses per prescription 15.6 vs 12.2, $p=0.01$). Among residents, we found that doses prescribed varied by resident year. PGY2 residents prescribed significantly more doses per prescription than PGY1 residents (18.4 vs 13.9, $p<0.01$) and PGY3 +residents (18.4 vs 14, $p<0.01$).

DISCUSSION

This study presents a description of opioid prescriptions written for acute injuries which shows some prescribing characteristics that are concerning. Specifically, there was a wide variation in the number of doses prescribed per prescription, as shown in figure 1, which may reflect the lack of prescriber guidelines for children with acute injuries. This data echoes inpatient prescription data that was reported earlier from our institution,[12] and variation in opioid prescribing practices for pediatric populations has been described in other institutions and in other clinical settings, suggesting that this variability is not limited to our institution.[11]

Liquid formulation was prescribed in more than half the prescriptions and was not limited to young children. Although data about formulation of medications accidentally ingested is limited, previous studies have demonstrated that liquid formulation is involved in large proportions of ingestions of cough and cold medications, acetaminophen and antibiotics.[4 14–16]

Furthermore, we identified instances in which no formulation or quantity to be dispensed was specified. Some studies suggest that many adverse drug events occur from prescribing errors, which implies that the described prescriptions may place children at increased risk of harm.[12 17–19]

In our study sample, oxycodone was the most common opioid prescribed for acute injuries. This is likely institutional preference, due to oxycodone's availability as a single agent. This data is also reflective of inpatient data previously reported from our institution.[12]

Residents were more likely to prescribe a higher number of doses per prescription when compared with non-residents. This may be related to professional experience, as demonstrated in other studies evaluating analgesia prescribing practices by year of provider experience.[20] Additionally, PGY2 residents were more likely to prescribe a higher number of prescriptions than PGY1 or PGY3 residents. Given that our institution provides all residents with an institutional DEA number at the start of residency, all residents are equally able to prescribe opioids regardless of year of training. However, PGY2 residents have clinical rotations on hematology and oncology services, where there may be a larger volume of opioid prescriptions written for palliative care, chronic pain conditions such as sickle cell anemia, and so on. Prescribing practices for these conditions may influence PGY2 residents' prescribing practices with acute care patients, thus explaining the uptick in PGY2 residents opioid prescribing practices in the ED compared with other residents.

This study has several limitations. First, this is a retrospective, single-center study in an academic institution, which may limit generalizability to current national and international prescribing trends. However, this is not the first study to report variability in opioid prescribing in a variety of clinical settings.[11 20 21] Second, our study focused on the characteristics of the initial prescription and intended dosing; we were unable to verify if the prescriptions were filled or what percentage of doses was taken by the patients. This is particularly relevant in cases where prescription error was noted, such as volume to be dispensed as 'one bottle.'

Exposures to opioids have a number of implications for patient safety and abuse trends. Opioids play a dominant role in pharmaceutical overdose deaths.[22] Studies have shown an association with increasing availability of opioids in adults with increasing pediatric exposures and poisonings.[8] Exposures tend to have a bimodal distribution, peaking in children less than 5 years of age and then again among adolescents.[6 22] From 1999 to 2016, mortality rates related to opioid poisonings increased by 225% in children 0–4 years and by 252.6% in adolescents aged 15–19 years.[3] Our data show that, in addition to other possible modes of exposure, these patients are also exposed to opioids via prescriptions for acute injuries.

This study highlights the need for future research related to pediatric opioid prescribing. The wide variation in number

of doses prescribed supports the need for more opioid prescribing guidelines for pediatric acute injuries, including route of administration, number of doses, and preferred analgesic. While our study did not evaluate non-opioid prescriptions for acute injuries, non-opioid options should also be considered in prescribing guidelines. In a study by Drendel *et al*, ibuprofen was shown to be preferable to acetaminophen with codeine for outpatient management of uncomplicated arm fractures, and the median number of doses was approximately four.[23] In the Pain Reduction for Extremity Injuries (PRIME) randomized clinical trial, intranasal ketamine was non-inferior to intranasal fentanyl for pain related to acute extremity injuries.[24] Exposure to opioids in the pediatric population may increase the risk for potential accidental or intentional ingestion. In addition to including non-opioid options for treatment of pain, pediatric guidelines should address the need for these patients and their caretakers to receive education on safe use, storage, and disposal of opioids, as national surveys show that many homes have unsafely stored opioids, particularly in homes with older children and teens.[25 26]

This study also highlights the need for more resident training. Opioid prescriptions are being written at multiple levels of pediatric training and those with less experience were more likely to prescribe more opioids than those with more years of experience.[13 20] Medical education should include proper opioid prescribing practices, risks of prescribing opioids, prescriptions, and preferred analgesics for pain management.

Contributors LR and LKK conceived and designed the study. LR supervised the conduct of the study and data collection. LKK collected and managed the data. LR, MWS, ACG, ESM, and LKK provided advice on study design. LR and LKK analyzed the data. LKK drafted the manuscript, and all authors contributed substantially to its revision. LR and LKK take responsibility for the paper as a whole.

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