



Original Contribution

Association of age and opioid use for adolescents and young adults in community emergency departments☆



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ABSTRACT

Objectives: Adolescents and young adults are at high risk for opioid misuse and abuse. The emergency department (ED) plays a key role in treatment of acute and chronic pain and is a primary place that this patient population is exposed to prescription opioids. We evaluate the effect of patient age on use of opioids for adolescents and young adults in community EDs.

Methods: Retrospective cohort study of adolescent and young adult encounters in 14 community EDs from 2013 to 2014. We evaluate the percent of ED encounters with parenteral and/or oral opioids administered, morphine milligram equivalents per ED patient encounter, and percent of patient encounters discharged with an opioid prescription. Age was the main exposure. The association between outcomes and age was examined using bivariate and multivariate logistic regression adjusting for measurable confounders.

Results: There were 259,632 adolescent and young adult encounters in our sample, average age 17.6 years, with 15.8% given opioids. Increasing patient age was associated with a significant increase in the percent of encounters with opioids given (AOR, 1.11; 95% CI 1.10–1.11), morphine milligram equivalents administered (β 0.38; 95% CI 0.33–0.43 for parenteral and β 0.26; 95% CI 0.23–0.28 for oral), and percent of patients receiving outpatient prescriptions (AOR, 1.14; 95% CI 1.13–1.14). Significant variability also existed between medical centers (AOR, 2.02; 95% CI 1.86–2.20).

Conclusion: For adolescent and young adult patients in the ED, there is a significant association between opioid prescribing and increasing age. This describes an opportunity to reduce opioid use in older adolescents and young adults.

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1. Introduction

The United States is now firmly entrenched in an epidemic of opioid abuse and overdose. Adolescent and young adult patients have experienced dramatic increases in exposure to opioids for the treatment of

acute and chronic pain [1,2]. Recent data show that 17.6% of high school seniors have received a prescription for opioids [3], and that exposure to these legitimate prescriptions can put youth at risk for future misuse. This can be true even among adolescents who otherwise have low risk for drug abuse or those who strongly disapprove of illegal drug use [4–7]. Adolescents who self-report medical and nonmedical use of prescription opioids were more likely to report that the medical use came prior to the nonmedical use [8], and 80% of teenagers that use opioids illicitly reported using remaining opioid prescription medication [4]. Ultimately, nearly 1 in 10 acknowledge misusing opioids [4,9], making prescription opioids the second most commonly abused substances by adolescents and young adults, surpassed only by marijuana [10].

Adolescents and young adults have been reported to sell, trade, or give away their prescription medications [11,12]. More than one-third of prescribed analgesics have reportedly been diverted by students [13], in addition to the misuse of old prescriptions [3,14] and the misuse

Abbreviations: ED, emergency department; GEE, generalized estimating equations; ICD-9, International Classification of Disease, 9th revision; KPSC, Kaiser Permanente Southern California; MME, morphine milligram equivalents.

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of prescriptions of peers [15]. Baseline opioid use has also been shown to be associated with suicidal ideation and suicide attempts at follow-up [16].

This rise in use and misuse of prescription opioids has led to a dramatic increase in emergency department (ED) visits and hospitalization for overdose [17]. Accidental ingestion of opioids by younger children and intentional overdose by adolescents and young adults is a significant issue leading to thousands of hospitalizations per year, with the majority of patients reporting that they obtained the medication in their own home, often in the form of leftover prescriptions [18–21].

There has been a call for research to help guide physicians in balancing the need for opioids in the acute ED setting with the risk of these adverse consequences [22]. For adolescents and young adults, EDs are a major source of first time opioid prescriptions [23]. Studies have shown that adolescents received an opioid medication as a discharge prescription in roughly 12% of all ED visits, between 14 and 23% of pain-related ED visits, and between 5 and 30% of visits related to headache or migraine [1,24,25]. However, within the adolescent and young adult population treated in EDs, it is not known when opioid administration and prescribing accelerates, specifically with respect to the administration of parenteral opioids as a treatment in the ED. Parenteral opioids are known to increase euphoric effects [26,27]. This could have a significant impact on the risk of future misuse and abuse. The goals of this investigation are to examine factors associated with opioid administration in the ED and prescriptions from the ED to adolescents and young adults in a large managed care health system. We examine patient level factors associated with increased risk for exposure to parenteral and oral opioids during the ED visit, and higher probability of receiving an opioid prescription at ED discharge. Additionally, for patients who received opioids, we determine how age affects the dose administered. Finally, we explore facility level variation in opioid administration and prescriptions.

2. Methods

2.1. Study design

We conducted a retrospective cohort study to evaluate opioid prescribing patterns from January 1, 2013 to December 31, 2014 in 14 community EDs within an integrated health delivery system, Kaiser Permanente Southern California (KPSC).

2.2. Study setting and population

KPSC provides health care to over four million members and study EDs see an annual volume of patients ranging from 25,000 to 90,000, totaling about 900,000 visits per year. Of these ED visits, approximately 19% are pediatric and 70–80% are health plan members.

2.3. Study protocol

All patients 10 to 23 years of age that visited a KPSC ED between January 1, 2013 and December 31, 2014 were included in the study. We used the age range of 10 to 23 years to define our population in order to follow the trend of opioid use across a broader age continuum that can share similar developmental and societal roles (<http://apps.who.int/adolescent/second-decade/section2/page1/recognizing-adolescence.html>).

2.4. Measurements

The primary interest was age at ED visit, assessed as a continuous variable. The outcomes of interest were opioids given at ED visit (total, parenteral, and oral), morphine milligram equivalents (MME) of opioid administered (parenteral and oral), and opioid prescription at discharge. In addition, various patient and encounter variables were included for analysis: race/ethnicity; gender; insurance status; emergency department; primary diagnosis of ED visit; Emergency Severity Index given at

triage; and disposition. The Elixhauser comorbidity index was used for risk adjustment of any chronic medical conditions [28]. We also created a new ED opioid prescribing variable to adjust for any changes in opioid prescribing after implementation of an ED opioid recommendation adopted by our study EDs in January 2014 [29].

All data were obtained from KPSC's electronic medical records which include information about health plan membership, health care utilization, diagnoses, pharmacy, and all clinical data captured as part of the electronic health record documentation. Patients in the opioid cohort were identified based on the pharmacy database, specifically use of parenteral hydromorphone, morphine sulfate, fentanyl, or meperidine as well as oral oxycodone, hydrocodone, morphine, codeine, and hydromorphone prescribed by an emergency physician.

To evaluate the use of opioids across different diagnoses we used the Clinical Classifications Software for International Classification of Disease, 9th revision (ICD-9-CM). As noted on the website (<https://www.hcup-us.ahrq.gov/toolssoftware/ccs/ccs.jsp#download>), the ICD-9-CM's codes are collapsed into a smaller number of clinically meaningful categories. The calculation for morphine equivalents was based on previously established methods [30–32].

2.5. Data analysis

The distributions of demographic and clinical characteristics of the study cohorts were stratified by those prescribed opioids during the ED visit and those who were not; differences were assessed using bivariate generalized estimating equations (GEE) regression with logistic distribution accounting for correlations among multiple encounters for the same patient. The associations between an opioid prescription and age were evaluated using these same methods. Predicted percentage of ED encounters receiving an opioid prescription per age was plotted based on the adjusted GEE logistic regression using age as a continuous variable. Identical analyses were performed for parenteral opioid prescription and oral opioid prescription.

Next, we examined whether the prescribed MME was associated with age at ED visit. This was evaluated using bivariate and multivariable general mixed models treating age as a continuous variable. Predicted MME of oral opioids by age was plotted. The analyses were repeated for MME of parenteral opioid among those with parenteral opioid prescribed at the ED visit. The MME was adjusted for patient weight. The weight measured within six months of the ED visit and closest to ED visit was used (most are from the same ED encounter). If no weight was recorded within 6 months of ED visit (approximately 4% of encounters), the missing value was replaced with the mean weight conditional on age and gender in our study sample.

To evaluate the association between an opioid prescription at discharge and age, we restricted the study cohort to patients with Kaiser insurance and those that were discharged home from the ED. We limited our outpatient prescription analysis to Kaiser members because our data set does not accurately capture outpatient prescriptions for those with different insurance. Again, the associations were examined using bivariate and multivariable GEE logistic regression adjusting for all patient encounter and facility variables. Predicted percentage of discharge prescriptions by age was plotted based on the multivariable GEE logistic regression using age as a continuous variable. All analyses were conducted using SAS version 9.3, Cary, North Carolina, USA.

This study was approved by the Kaiser Permanente Southern California Institutional Review Board according to the declaration of Helsinki and federal regulations. Consent was waived.

3. Results

3.1. Demographic and clinical characteristics

There were 259,632 encounters included for patients aged 10 to 23 years with a mean age of 17.6 (3.9 SD) years, 55% were female.

Characteristics of the study sample are given in Table 1. Overall 15.8% (41,017 of 259,632) received opioids during their ED encounter. Of these, 74.2% (30,447 of 41,017) received a parenteral opioid and 30.2% (12,405 of 41,017) received an oral opioid.

On multivariable analysis, multiple factors were found to be independently associated with differential odds of being administered any opioid during the ED encounter (Table 2). Male gender was associated with decreased odds of receiving opioids, while white race was associated with modestly increased odds (AOR, 0.95; 95% CI, 0.92–0.97 and AOR, 1.13; 95% CI, 1.08–1.17). Patients with higher triage categories (AOR, 3.08; 95% CI, 2.99–3.18), a higher comorbidity index (AOR, 1.09; 95% CI, 1.04–1.14), and those admitted to the hospital (AOR, 4.66; 95% CI, 4.47–4.87), were also more likely to receive opioids. Patients with musculoskeletal disease (AOR, 4.08; 95% CI, 3.81–4.38), injury (AOR, 3.86; 95% CI, 3.67–4.06), and neoplasms (AOR, 3.58; 95% CI, 2.64–4.84) were more likely to receive opioids, while patients with mental illness (AOR, 0.26; 95% CI, 0.23–0.29) were less likely when compared to those presenting with a baseline group of cardiovascular and respiratory illness. In addition, we observed significant variation between medical centers with a greater than twofold higher odds of opioid administration between the lowest and highest prescribing EDs (AOR, 2.02; 95% CI, 1.86–2.20).

3.2. Predicted probability of opioid use per age

Patient age was significantly associated with opioid administration during the ED encounter, for total opioid use (AOR, 1.11; 95% CI, 1.10–1.11) (Table 2) and in the parenteral and oral subgroups (AOR, 1.11; 95% CI, 1.10–1.12; AOR, 1.08; 95% CI, 1.07–1.09, respectively) (data not shown). The adjusted probability of receiving an opioid in the ED increased every year based on patient age (10 years 7.0% to 23 years 22.6%), a result of increases in both parenteral (4.4% to 17.7%) and oral opioids (2.9% to 6.2%) (Fig. 1). The MME dose also significantly increased each year from 3.46 at 10 years to 8.31 at 23 years for parenteral (β 0.38; 95% CI 0.33–0.43), and from 4.63 at 10 years to 8.56 at 23 years for oral (β 0.26; 95% CI 0.23–0.28) (Table 3) (Fig. 2). Lastly, the predicted probability of outpatient prescriptions per age (Fig. 1) also showed a significant increase from an average of 5.0% of encounters receiving an outpatient prescription at 10 years of age to 19.0% at 23 years of age, with a significant increase noted yearly (AOR, 1.14; 95% CI, 1.13–1.14) (Table 2).

3.3. Milligram of morphine equivalents administered in the ED

When administered, the mean (SD) oral and parenteral dose of opioids in MMEs administered was 7.2 (SD 4.7) and 7 (SD 14.3), respectively. Table 3 shows the results of the multivariable linear mixed model with MME administered as the outcome. Female patients on average received 0.88 (95% CI: 0.52–1.23) more parenteral MMEs and 0.43 (95% CI 0.26–0.59) more oral MMEs than male. Compared with Hispanic patients, Black patients received higher doses of opioids (β 2.02; 95% CI 1.47–2.57 and β 0.39; 95%CI 0.13–0.65 for parenteral and oral, respectively). Patients with a higher comorbidity index and those admitted to the hospital received higher doses of opioids.

3.4. Factors associated with receiving an outpatient opioid prescription from the ED

This subgroup analysis was restricted to Kaiser insurance members that were discharged to home (to allow for tracking of prescriptions), which comprised 63.1% (163,920 of 259,632) of the total group. Overall, 11.7% of all patient encounters, including both pain and non-pain related encounters, had an associated outpatient opioid prescription. Factors associated with higher odds of receiving an outpatient prescription for opioids, in addition to age discussed above, included White race more likely than Hispanic (AOR, 1.11; 95% CI, 1.06–1.15) and higher

Table 1
Demographics and clinic characteristics for emergency department encounters with adolescent and young adult patients stratified by those who did and did not receive opioids.

	With opioid prescription (N = 41,017)	Without opioid prescription (N = 218,615)	P-value*
Age at ED visit, mean (SD)	18.8 (3.44)	17.4 (3.92)	<0.001
Age, n (%)			<0.001
10–13	3893 (9.5%)	44,579 (20.4%)	
14–17	8845 (21.6%)	59,759 (27.3%)	
18–21	17,027 (41.5%)	73,553 (33.6%)	
22–23	11,252 (27.4%)	40,724 (18.6%)	
Gender, n (%)			<0.001
Female	24,179 (58.9%)	118,549 (54.2%)	
Male	16,838 (41.1%)	100,066 (45.8%)	
Race/ethnicity, n (%)			<0.001
Asian/Pacific Islander	1344 (3.3%)	9360 (4.3%)	
Black	4958 (12.1%)	25,847 (11.8%)	
Hispanic	19,061 (46.5%)	100,423 (45.9%)	
White	8477 (20.7%)	38,112 (17.4%)	
Other/multiple/unknown	7177 (17.5%)	44,873 (20.5%)	
Insurance, n (%)			<0.001
Non-Kaiser	12,553 (30.6%)	72,794 (33.3%)	
Kaiser Permanente	28,464 (69.4%)	145,821 (66.7%)	
Emergency Severity Index (given at triage), n (%)			<0.001
1	14 (0%)	57 (0%)	
2	1513 (3.7%)	9404 (4.3%)	
3	30,711 (74.9%)	105,759 (48.4%)	
4	8670 (21.1%)	99,072 (45.3%)	
5	109 (0.3%)	4323 (2%)	
Primary diagnosis, n (%)			<0.001
Infectious and Parasitic Diseases	588 (1.4%)	4332 (2%)	
Neoplasms	114 (0.3%)	144 (0.1%)	
Mental illness	309 (0.8%)	14,452 (6.6%)	
Disorders of the nervous system and sense organs	3180 (7.8%)	17,689 (8.1%)	
Diseases of the GI and GU system	11,125 (27.1%)	24,856 (11.4%)	
Complications of pregnancy, childbirth, and the puerperium	1224 (3%)	9094 (4.2%)	
Diseases of the skin and subcutaneous tissue	907 (2.2%)	7232 (3.3%)	
Diseases of the musculoskeletal system and connective tissue	2131 (5.2%)	9492 (4.3%)	
Injury and poisoning	10,517 (25.6%)	62,479 (28.6%)	
Symptoms including syncope, fever, abdominal pain, and malaise	7392 (18%)	31,088 (14.2%)	
Diseases of the respiratory and cardiovascular symptoms	2525 (6.2%)	34,249 (15.7%)	
Other	1005 (2.5%)	3508 (1.6%)	
Elixhauser comorbidity index, n (%)			<0.001
0	19,856 (48.4%)	112,477 (51.4%)	
1	11,813 (28.8%)	68,779 (31.5%)	
2 or above	9348 (22.8%)	37,359 (17.1%)	
Disposition, n (%)			<0.001

Table 1 (continued)

	With opioid prescription (N = 41,017)	Without opioid prescription (N = 218,615)	P-value*
Discharge to home	33,206 (81.0%)	204,668 (93.6%)	
Admit to acute care	7383 (18.0%)	6558 (3.0%)	
Other	428 (1.0%)	7389 (3.4%)	
Institution of new narcotic guideline, n (% ^a)			<0.001
No	20,941 (51.1%)	106,593 (48.8%)	
Yes	20,076 (49.0%)	112,022 (51.2%)	
Medical center, n (% ^b)			<0.001
ED 1	21,837 (87.4%)	3160 (12.6%)	
ED 2	25,163 (83%)	5142 (17%)	
ED 3	25,534 (84.4%)	4735 (15.6%)	
ED 4	15,480 (85.3%)	2674 (14.7%)	
ED 5	10,596 (79.4%)	2752 (20.6%)	
ED 6	13,635 (82.8%)	2833 (17.2%)	
ED 7	9410 (83.9%)	1804 (16.1%)	
ED 8	12,308 (82.7%)	2579 (17.3%)	
ED 9	13,888 (83.7%)	2708 (16.3%)	
ED 10	10,604 (84.2%)	1997 (15.8%)	
ED 11	21,688 (84.1%)	4104 (15.9%)	
ED 12	13,795 (83.7%)	2681 (16.3%)	
ED 13	16,288 (86.8%)	2467 (13.2%)	
ED 14	8389 (85.9%)	1381 (14.1%)	

* Descriptive statistics are based on encounter level data, while P-value is from univariate mixed logistic regression accounting for correlation of multiple encounters for the same patient.

^a Row percentage within each column.

^b Column percentage within each row.

triage categories (AOR, 1.13; 95% CI, 1.09–1.17) (Table 2). Here again, we observed significant variation between medical centers with a two-fold increase from least use to most use (AOR, 2.00; 95% CI, 1.80–2.22).

4. Discussion

We found that advancing age was consistently associated with increased opioid use and dose for our adolescent and young adult ED population, and that patients had a 15% increase in opioid prescribing from 10 to 23 years of age, with a >13% increase (from 4% to 18%) in parenteral use. The dose of opioids increased by 4.8 MMEs (parenteral: from 3.5 to 8.3) and 4 MMEs (oral: from 4.6 to 8.6) as well. Not only were opioids prescribed more frequently but also at significantly higher doses; and we did not see a plateau in prescribing or dose as age increased. We expected to see an increase in use that would plateau in older adolescence, a time when weight and body mass stabilize along with medication usage and dosing. What we found though was a significant, continued yearly increase throughout later adolescence and young adulthood in the percent of patients receiving opioids and in the doses given. Based on this data, potentially thousands of opioid ED and outpatient prescriptions could be avoided if we prescribed the same for older adolescents and young adults as we do for younger ones. We

Table 2

Adjusted Odds Ratio from logistic regression for overall (parenteral and oral) opioid use in the emergency department and outpatient opioid prescriptions from the emergency department in adolescent and young adult patients.

	Overall opioid in ED			Opioid outpatient prescription		
	OR	95% CI		OR	95% CI	
Age, year	1.11	1.10	1.11	1.14	1.13	1.14
Gender						
Female	Reference	–	–	Reference	–	–
Male	0.95	0.92	0.97	0.99	0.96	1.02
Race/ethnicity						
Hispanic	Reference	–	–	Reference	–	–
Asian/Pacific Islander	0.77	0.72	0.82	0.77	0.71	0.83
Black	1.00	0.95	1.05	0.99	0.94	1.05
White	1.13	1.08	1.17	1.11	1.06	1.15
Other/multiple/unknown	0.93	0.89	0.97	1.05	0.95	1.16
With Kaiser membership						
No	Reference	–	–	N/A ^a		
Yes	1.08	1.04	1.12			
Emergency Severity Index (given at triage)						
Level 4–5	Reference	–	–	Reference	–	–
Level 1–3	3.08	2.99	3.18	1.13	1.09	1.17
Primary diagnosis						
Diseases of the respiratory and cardiovascular systems	Reference	–	–	Reference	–	–
Complications of pregnancy, childbirth, and the puerperium	0.92	0.85	1.00	0.27	0.23	0.30
Diseases of the GI and GU system	3.68	3.50	3.88	1.19	1.12	1.26
Diseases of the musculoskeletal system and connective tissue	4.08	3.81	4.38	1.84	1.71	1.99
Diseases of the skin and subcutaneous tissue	2.32	2.13	2.53	1.31	1.19	1.45
Disorders of the nervous system and sense organs	2.33	2.18	2.48	0.82	0.76	0.88
Infectious and Parasitic Diseases	1.26	1.14	1.40	0.96	0.84	1.10
Injury and poisoning	3.86	3.67	4.06	1.65	1.56	1.74
Mental illness	0.26	0.23	0.29	0.06	0.05	0.07
Neoplasms	3.58	2.64	4.84	1.44	0.77	2.68
Symptoms including syncope, fever, abdominal pain, malaise	2.85	2.71	3.01	0.52	0.49	0.56
Other	1.52	1.29	1.80	0.41	0.32	0.52
Elixhauser comorbidity index						
0	Reference	–	–	Reference	–	–
1	1.00	0.97	1.03	0.99	0.95	1.03
2 or above	1.09	1.04	1.14	0.95	0.90	0.99
Disposition						
Discharge to home	Reference	–	–	N/A ^b		
Admit to acute care	4.66	4.47	4.87			
Other	0.47	0.43	0.53			
Institution of new narcotic guideline						
No	Reference	–	–	Reference	–	–
Yes	0.90	0.88	0.93	0.87	0.84	0.89
Medical center						
ED 14	Reference	–	–	Reference	–	–
ED 1	1.07	0.98	1.16	1.03	0.93	1.14
ED 2	1.18	1.09	1.27	1.80	1.64	1.98
ED 3	1.23	1.14	1.33	1.77	1.60	1.95
ED 4	0.95	0.88	1.04	1.21	1.09	1.35
ED 5	2.02	1.86	2.20	0.51	0.43	0.60
ED 6	1.21	1.11	1.32	1.22	1.10	1.36
ED 7	1.20	1.10	1.32	1.26	1.12	1.41
ED 8	1.42	1.30	1.56	1.59	1.43	1.77
ED 9	1.31	1.20	1.43	1.33	1.19	1.48
ED 10	1.29	1.18	1.41	2.00	1.80	2.22
ED 11	1.04	0.96	1.13	1.56	1.41	1.71
ED 12	1.22	1.12	1.34	1.08	0.96	1.20
ED 13	1.04	0.95	1.13	1.35	1.21	1.51

^a Outpatient analysis restricted to Kaiser members.

^b All discharged.

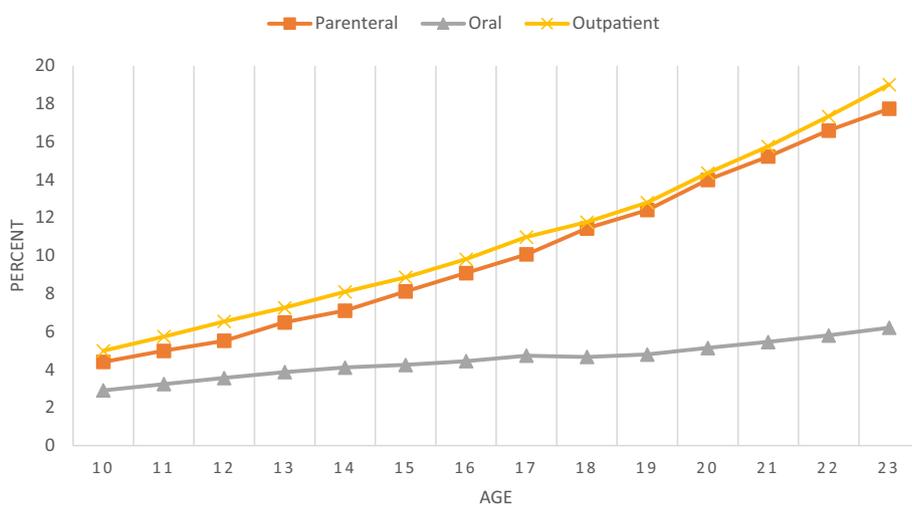


Fig. 1. Predicted probability of receiving an opioid prescription for an emergency department visit stratified by patient age: parenteral and oral in the emergency department and as an outpatient prescription.

acknowledge though that this trend is likely multifactorial, and also reflects changing risk profiles, disease processes, and increasing independence from caretakers, and that decreasing use of opioids in this older adolescent and young adult population is not a straightforward process.

Overall, 15.8% of our patients received opioids during their ED encounter. This compares to past studies which have shown between 14.5% and 23% use [1,23]. We also found that White patients were more likely than Hispanics to receive opioids, and females more likely than males. Past studies have shown that females are a subgroup that is found to be more associated with opioid use [33], and that they are at risk for misuse and abuse related to opioid prescriptions [11].

Past studies looking at opioid misuse and abuse have shown that adolescence and young adulthood can be a high-risk time for exposure to opioid medications. This age group is at risk of non-medical use of prescription opioids, including personal use and the sharing, trading, or selling of prescription medications among peers [11,12], and overdose or suicide [16,21]. Unfortunately, we have shown in this study that as children age into adolescence and progress through it, they are given opioids in increasing frequency and at higher doses.

Our study adds to the literature in this field by increasing understanding of ED opioid prescribing as well as identifying the association between age and opioid prescribing among an adolescent and young adult population. This is particularly important because we know that this group is less likely to have routine medical care and accordingly use the ED as a primary source of health care [34–37]. Many adolescents and young adults with addiction issues have their first encounter with an opioid medication in an ED [6]. It is also known that when opioids are injected (as opposed to taken orally), the sense of euphoria can be more pronounced [26,27]. Thus, the use of parenteral opioid medication needs to be considered, along with discharge prescriptions, in terms of its potential to impact future use and misuse.

Our study gives an overview of factors that are associated with opioid prescribing in adolescent and young adult patients, and shows this direct relationship with increasing age and increasing prescribing. We believe that this prescribing in the ED setting has the potential to affect future use and thus needs to be evaluated more closely, particularly in the community hospital setting where the expertise of the provider is not wholly focused on pediatric and adolescent medicine. ED physicians need to continue to be mindful of opioid prescribing in this population. The older adolescent and young adult age group (16–23 years) might be a good target for an intervention aimed at decreasing opioid prescribing.

There is also a significant variation in opioid use between EDs with a twofold increase in use from least use to most use. This is not surprising

in our health care system as even though we are a health maintenance organization with an integrated medical record, there is still local control over provider education and oversight of patient care. This variation though is another indication that improvements can likely be made for more judicious prescribing of opioids. A potential next step from our results could be implementing specific recommendations targeted at adolescents and young adults. This combined with continued education of patients and parents in the ED setting on the risk of opioids could have a significant clinical impact.

4.1. Limitations

First, this was a retrospective study and thus the findings are associations and not causal relationships. Second, our study was not able to measure important characteristics related to opioid prescribing such as the patient's perception of their pain while in the ED, patient satisfaction with the visit, or whether patients actually used their discharge medications as indicated. Third, we did not evaluate for return visits related to the primary complaint and cannot obtain data on patients that might have gone to an outside ED after their visit for the same issue. Fourth, we relied on data abstraction using the electronic medical record, and identifying cohorts for subgroup analysis using ICD-9 codes, which are potentially subject to inaccuracy. Fifth, the study included both Kaiser insurance members and non-members. We included the non-members as they comprise 32.9% of the study sample. This group was excluded though from the analysis of outpatient prescriptions as these patients generally do not receive their outpatient prescriptions within our system. Sixth, we used encounter level data, rather than provider or patient level data. The limitation of this approach is that the likelihood of opioid use for a given patient with repeat visits is not entirely independent on separate encounters. However, we accounted for this in the analysis and felt it was important to not exclude encounters by limiting to the patient's first visit because these patients with repeat visits are an important, even though small percentage, group in this investigation on opioid use. The average visits per patient were 1.5.

4.2. Conclusions

As children age into adolescence and young adulthood, when the risks for opioid misuse and abuse are potentially greatest, we found a significant associated risk of ED opioid prescribing. This association includes the percentage of ED encounters receiving parenteral or oral opioids, the total dose of opioids, and the percentage of outpatient prescriptions related to the encounter. This relationship remained

Table 3
Adjusted estimate (β) and standard error from general mixed model for parenteral and oral MMEs given to adolescent and young adult patients in the emergency department with age as a continuous variable.

	Opioid parenteral				Opioid oral			
	Change in MME	95% CI		P-value	Change in MME	95% CI		P-value
Intercept	−2.78	−4.44	−1.12	0.001	−0.53	−1.23	0.17	0.136
Age	0.38	0.33	0.43	<0.001	0.26	0.23	0.28	<0.001
Weight	−0.001	−0.004	0.003	0.805	0.005	0.003	0.007	<0.001
Gender				<0.001				<0.001
Female	Reference	–	–		Reference	–	–	
Male	0.88	0.52	1.23	<0.001	0.43	0.26	0.59	<0.001
Race/ethnicity				<0.001				<0.001
Hispanic	Reference	–	–		Reference	–	–	
Asian/Pacific Islander	−0.40	−1.29	0.49	0.379	−0.36	−0.82	0.11	0.135
Black	2.02	1.47	2.57	<0.0001	0.39	0.13	0.65	0.004
White	0.60	0.16	1.04	0.008	0.11	−0.10	0.33	0.296
Other/multiple/unknown	0.70	0.14	1.26	0.014	0.14	−0.12	0.40	0.281
With Kaiser membership				0.876				0.841
No	Reference	–	–		Reference	–	–	
Yes	0.04	−0.41	0.48	0.876	0.02	−0.19	0.24	0.841
Emergency Severity Index (given at triage)				0.550				<0.001
Level 4–5	Reference	–	–		Reference	–	–	
Level 1–3	0.18	−0.40	0.75	0.550	0.64	0.47	0.81	<0.001
Primary diagnosis				<0.001				<0.001
Diseases of the respiratory and cardiovascular systems	Reference	–	–		Reference	–	–	
Complications of pregnancy, childbirth, and the puerperium	−0.81	−1.90	0.28	0.146	0.90	0.28	1.53	0.005
Diseases of the GI and GU system	0.01	−0.73	0.75	0.974	1.14	0.79	1.49	<0.001
Diseases of the musculoskeletal system and connective tissue	0.89	−0.15	1.94	0.093	1.39	1.02	1.76	<0.001
Diseases of the skin and subcutaneous tissue	0.93	−0.45	2.31	0.185	1.07	0.60	1.55	<0.0001
Disorders of the nervous system and sense organs	1.08	0.20	1.96	0.017	1.32	0.94	1.70	<0.001
Infectious and Parasitic Diseases	−0.15	−1.55	1.25	0.829	−0.80	−1.53	−0.06	0.035
Injury and poisoning	1.02	0.23	1.81	0.011	1.13	0.84	1.41	<0.001
Mental illness	−0.66	−2.70	1.38	0.525	0.59	−0.22	1.40	0.151
Neoplasms	1.51	−1.24	4.26	0.283	2.63	0.88	4.37	0.003
Symptoms including syncope, fever, abdominal pain, malaise	−0.02	−0.78	0.74	0.964	0.96	0.54	1.38	<0.001
Other	9.78	8.59	10.96	<0.0001	2.79	2.02	3.55	<0.001
Elixhauser comorbidity index				<0.001				<0.001
0	Reference	–	–		Reference	–	–	
1	0.20	−0.18	0.59	0.299	0.11	−0.07	0.30	0.230
2 or above	1.78	1.35	2.22	<0.001	0.76	0.52	0.99	<0.001
Disposition				<0.001				<0.001
Discharge to home	Reference	–	–		Reference	–	–	
Admit to acute care	2.16	1.76	2.56	<0.001	3.26	2.95	3.58	<0.001
Other	1.05	−0.36	2.47	0.145	2.71	1.81	3.62	<0.001
Institution of new narcotic guideline				0.097				0.278
No	Reference	–	–		Reference	–	–	
Yes	−0.27	−0.58	0.05	0.097	−0.08	−0.24	0.07	0.278
Medical center				<0.001				<0.001
ED 14	Reference	–	–		Reference	–	–	
ED 1	0.003	−1.06	1.06	0.995	0.11	−0.39	0.61	0.670
ED 2	0.08	−0.91	1.08	0.869	−0.01	−0.48	0.46	0.962
ED 3	0.19	−0.82	1.20	0.709	0.43	−0.02	0.89	0.063
ED 4	−0.94	−2.02	0.15	0.091	−0.47	−0.97	0.03	0.066
ED 5	−0.84	−1.97	0.29	0.147	0.33	−0.15	0.80	0.182
ED 6	0.25	−0.82	1.31	0.651	0.61	0.11	1.11	0.020
ED 7	−0.37	−1.54	0.79	0.527	0.51	−0.03	1.06	0.068
ED 8	2.52	1.42	3.61	<0.001	0.70	0.20	1.19	0.007
ED 9	−0.57	−1.63	0.50	0.296	−0.33	−0.84	0.19	0.224
ED 10	0.56	−0.55	1.68	0.325	0.80	0.24	1.36	0.007
ED 11	−0.12	−1.12	0.89	0.823	1.03	0.56	1.51	<0.001
ED 12	−1.27	−2.35	−0.18	0.022	−0.16	−0.68	0.36	0.541
ED 13	−0.79	−1.90	0.31	0.161	−0.44	−0.96	0.08	0.101

significant and did not level off in the older adolescents, a time when weight and dosing often start to stabilize as patients' approach adult size. This suggests that there is a potential to reduce opioid prescribing in older adolescents and young adults, decreasing exposure to this potentially dangerous category of medication in this vulnerable patient population. Based on the findings of our study, providers in this setting could evaluate how age might be influencing their use of opioids in this population and look for opportunities to decrease its use. Further studies are needed to assess outcomes related to pain medication use in the ED setting, such as the patient's perception of pain relief during the encounter, the association with revisits for the same issue, and whether this prescribing is associated with future opioid use in terms of health

care visits and future prescriptions for opioid medications. In addition, we need to study interventions targeted at this group of patients to understand if they are successful at reducing future misuse and abuse of opioids.

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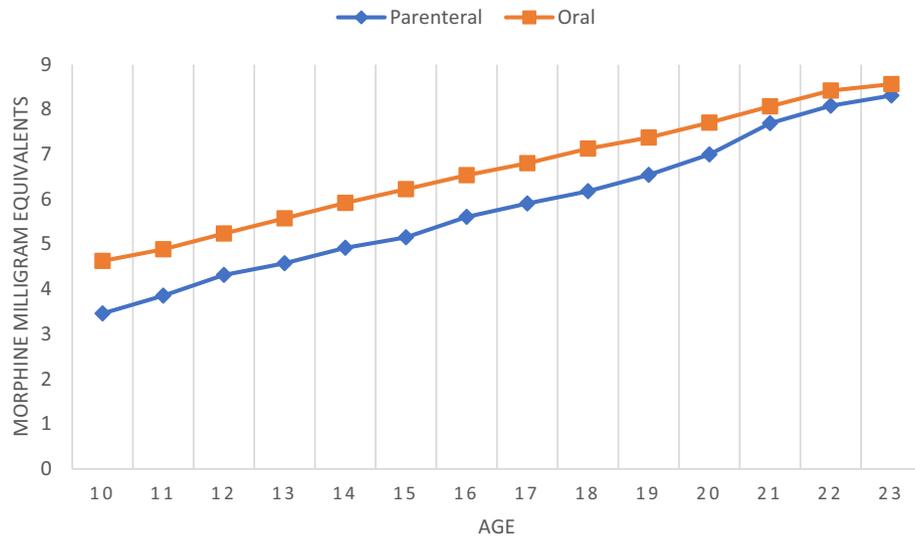


Fig. 2. Adjusted dose of morphine milligram equivalents for patients prescribed opioids during an emergency department visit stratified by age.

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