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Original Contribution

Use of opioids and analgesics among ED patients with dental and low back pain: A national perspective☆

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ABSTRACT

Objectives: Emergency department (ED) visits for dental pain and low back pain (LBP) are common. Many such patients have severe pain and receive opioids. Increased opioid-related deaths has led to efforts to reduce opioid prescriptions. We compared recent trends in use of analgesics and opioids in the ED and at discharge among patients with dental or LBP.

Methods: We conducted a secondary analysis of the National Hospital Ambulatory Medical Care Survey (NHAMCS) of patients with dental pain or LBP from 2010 to 2015. We performed univariate and multivariate analyses exploring the association between pain location and use of analgesics and opioids controlling for age, gender, and pain severity.

Results: There were an estimated 16 and 49 million patient visits for dental and LBP, respectively. Prescription of opioids at discharge decreased from 59% to 50% ($p = 0.02$) in dental and 46% to 39% in LBP patients ($p = 0.09$). Compared to patients with LBP, patients with dental pain were less likely to receive analgesics (OR 0.65, 95% CI, 0.57–0.74) or opioids (OR 0.51, 95% CI, 0.44–0.59) while in the ED. In contrast, dental pain patients were more likely to have analgesics (OR 1.32, 95% CI, 1.16–1.51) or opioids (OR 1.65, 95% CI, 1.47–1.85) prescribed at the time of ED discharge than patients with LBP.

Conclusions: Prescription of opioids decreased for ED dental patients. While less likely to receive analgesics and opioids in the ED, patients with dental pain were more likely to be prescribed analgesics and opioids at the time of ED discharge than those with LBP.

1. Introduction

Toothaches are an increasingly common reason for presenting to an emergency department (ED) throughout the United States and they present a unique problem for ED providers [1,2]. Firstly, the pain is often rated as very severe with a high proportion of patients reporting a high level of pain on numeric rating scales [3]. Secondly, the pain is often due to an underlying pathology that has 1) gone untreated for a significant time and has just reached a breaking point and 2) requires definitive treatment by a dental professional [2]. Emergency departments often do not staff dental professionals and therefore are not equipped to treat the underlying cause of the dental pain, and instead mostly provide analgesia which can be accomplished with NSAIDs, acetaminophen, opioids, local anesthetic, or a combination of multiple modalities [4]. It is not fully understood how analgesia is most often accomplished for toothaches in the ED setting.

Over the last few years the number of opioid-related deaths has dramatically increased. Based on data from the Centers for Disease Control and Prevention (CDC) over half a million patients died from drug overdoses from 2000 to 2015 and 91 Americans die every day from an opioid overdose [5]. This has captured the attention of both healthcare providers and the general public and has led to efforts to reduce the use of opioids [6,7]. Whether these efforts have had any impact on administration of opioids in the ED and their prescription at the time of ED discharge for patients with common and painful conditions, such as toothaches and LBP, is unknown.

The goal of this study is to investigate whether there has been a decrease in the administration of opioids in the ED and their prescription at the time of ED discharge for patients with dental or LBP. Specifically, we investigated the methods of analgesia used for managing dental pain in emergency departments in the United States. In order to assess if dental pain is treated differently than other painful conditions in the ED setting, we compared dental pain treatment modalities to the modalities used to treat lower back pain (LBP). LBP is another common complaint seen in the ED that is also often rated as very severe, and also due to an underlying cause that often cannot be addressed in the ED beyond analgesia. With these similarities between toothaches and LBP it can be useful to see how methods of analgesia compare between the two

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presentations and if the location of pain has an influence on how the pain is managed.

2. Methods

2.1. Study design and setting

We conducted a secondary analysis of data downloaded from the National Hospital Ambulatory Medical Care Survey (NHAMCS) for the latest years available (2010–2015). NHAMCS data are in publicly available files which can be accessed from the CDC website. As described by its developers, "The NHAMCS is an annual, national probability sample of ambulatory visits made to non-federal, general, and short-stay U.S. hospitals conducted by the Centers for Disease Control and Prevention, National Center for Health Statistics (NCHS). Although the survey includes visits to selected ambulatory care departments, this analysis focuses solely on the visits to hospital emergency departments (EDs). The multi-staged sample design is comprised of three stages for the ED component: 1) 112 geographic primary sampling units (PSUs); 2) approximately 480 hospitals within PSUs; and 3) patient visits within emergency service areas." [8]. Appropriate weights were applied using the procedure Complex Samples in SPSS. Per NHAMCS protocol, trained hospital staff members abstract ED visit data for all ED visits, including those who were ultimately admitted, using a structured data entry form during 4-week data periods randomly assigned for each sampled hospital. The sampled data are extrapolated to national estimates through use of assigned patient visit weights, which account for probability of visit selection, nonresponse, and ratio of sampled hospitals to the hospital universe.

2.2. Study patients

For this study a 'dental patient' was defined as any patient with a dental diagnosis (ICD-9 520.xx to 525.xx), dental trauma (ICD-9 873.63, 873.73), or with a reason for visit code indicating a dental problem: 15000 (symptoms of teeth and gums), 15001 (toothache), or 15002 (gum pain). In NHAMCS the primary diagnosis and up to 4 other diagnoses, at the discretion of the coder, can be listed. LBP patients were identified using only 'reason for visit' (RFV) as the identifier. Patients were identified as having LBP if at least one of the three RFV codes in the database were in the defined set of LBP codes shown in Appendix 1. We chose to compare patients with dental pain and low back pain since both of these conditions are common with varying treatment practice patterns. There is also evidence suggesting that both of these conditions can be successfully managed without prescription opioids [9,10].

2.3. Measures and outcomes

For the selected patients, demographic data including age, gender, health insurance type, and initial vital signs were extracted. Reported pain scores, and methods of analgesia were also collected. Pain severity was measured on a 0 to 10 verbal numeric scale from none (0) to most [10]. Pain was considered severe if the pain score was 7 or greater. A prior study found that the mean pain score in patients describing their pain as "horrible" was approximately 7 on the verbal numeric scale [11].

The primary outcome was administration of any analgesics while in the ED. Secondary outcomes were the administration of opioids while in the ED, prescription of any analgesics at the time of ED discharge, and the prescription of opioids at the time of discharge.

2.4. Data analysis

Descriptive statistics were used to summarize the data including means with standard deviations for continuous data, and numbers and percentages for categorical data. Groups were compared using chi-square or Mann Whitney *U* tests as appropriate. Linear regression was used to identify time trends in the administration or prescribing of analgesics. Logistic regression was used to determine the association between predictor variables (age, gender, pain, year) and outcomes in patients with low back and dental pain. For nonlinear associations between a continuous predictor and an outcome, groupings of the predictors were created and included as indicator variables. A p value < 0.05 was considered statistically significant.

3. Results

3.1. General characteristics of all patients

Between 2010 and 2015 there were an estimated 806 million ED visits in the U.S. There were an estimated 15.8 million ED visits for a dental problem representing 2.0% of all ED visits. There were also an estimated 49.0 million patient visits to the ED with a complaint of LBP, representing 6.1% of all visits. Of these, an estimated 183,920 (0.5% of LBP visits) also had a dental diagnosis as defined above. These were excluded from comparative analysis in order to have two independent samples, leaving an estimated 15.6 million dental and 48.8 million LBP patients for comparisons.

3.2. Patients with dental pain

For the roughly 16 million dental related visits, the mean patient age was 33, 12% were pediatric (<19 years old), 52% were female. Children (age < 10) were more likely to be male (65%), compared to teens and adults <65 (47%) and older adults (65+ years of age, 42%) ($p = 0.002$). Dental patients were more likely to be insured by Medicaid (34% vs. 28%, $p = 0.001$) or self-payed (31 vs. 15%, $p < 0.001$) than all other ED patients. With regards to time of ED presentation, 59% of dental patients arrived after work hours (4 PM to 8 AM), and 30% presented on weekends, when presumably there would be no access to dental offices. This distribution of patients by time and day was similar to the overall distribution for all patients visiting the ED.

Of the dental patients, 80% had a reported pain score and, of these, 74% had a severe level of pain at presentation (7 or higher). Females were more likely to report severe pain (78% vs. 71%, $p = 0.01$). Severe pain by age showed an inverted U shaped pattern with young children (age < 10 years) least likely to report severe pain, followed by older adults (>65 years) and teens/adults (21%, 44%, and 79%, respectively, $p < 0.001$). In a multivariate model including age and gender, both were significantly related to severe pain, as was the interaction of the two. For both males and females severe pain was more likely to occur in teens/adults but was relatively higher in female children compared to male children, and was relatively higher in older males than in older females shown in Table 1.

Of all dental patients, 44% were administered an analgesic while in the ED including opioids (30%), NSAIDS (14%), acetaminophen (5%), and/or a local or topical anesthetic (7%). The percentage of dental

Table 1
Association of age and gender with severe pain in patients with dental and low back pain.

Age/gender group	Odds ratio	95% CI
Patients with dental pain		
Females <10 years	0.19	0.05–0.70
Females 10–64	2.48	0.91–6.76
Females 65+	0.27	0.07–1.03
Males <10	0.14	0.04–0.52
Males 10–64	1.88	0.71–5.01
Males 65+	1 (ref)	–
Patients with low back pain		
Males	1 (ref)	–
Age < 10	0.39	0.19–0.83
Age 10–64	1.69	1.37–2.08
Age 65+	1 (ref)	–

patients administered an opioid while in the ED was similar across the 6-year study (Fig. 1). There were also no time trends in the use of analgesics or local anesthetics in the ED. Age and gender were not predictive of receiving an analgesic or opioid in the ED. Severe pain was positively associated with receiving an analgesic with 33% of patients with a pain score of <7 receiving an analgesic compared to 49% of those with severe pain ($p < 0.001$). Gender, age, and geographic region were not associated with receiving an opioid analgesic in the ED. Only pain severity in a logistic regression model was associated with opioid medication (Table 1). Age, gender, and severe pain were not related to the use of a local anesthetic in the ED.

Of all ED patients with dental pain, 64% were prescribed an analgesic prior to discharge from the ED including NSAIDS (21%), opioids (53%), acetaminophen (5%), and/or a local anesthetic (1%). Gender was not associated with analgesic medication or opioid analgesic prescriptions. Age showed an inverted U shape pattern with both analgesic prescription and opioid prescription (both $p < p.001$). Severe pain was associated with both prescribing any analgesia (72% vs. 48%, $p < 0.001$) and opioid prescribing (84% vs. 36%, $p < 0.001$). In a multivariate model only severe pain was associated with any analgesic and with opioid prescribed analgesia (Table 2). Age, gender, geographic region, and severe pain were not related to prescribing a local anesthetic in the ED. The percentage of dental patients prescribed opioids at discharge decreased significantly over the study period from 59% to 50% ($p = 0.02$, Fig. 1). There were no time trends in prescribing analgesics or anesthetics during this time frame (data not shown).

Table 2
Multivariate association of pain severity and age with administration or prescription of analgesics and opioids to patients with dental pain.

Factor	Any analgesia given		Opioid analgesia given	
	OR	95% CI	OR	95% CI
Pain score				
<7	1 (ref)	–	1 (ref)	–
7+	1.96	1.55–2.48	2.11	1.59–2.79
Factor	Any analgesia prescribed		Any opioid prescribed	
	OR	95% CI	OR	95% CI
Pain score				
<7	1 (ref)	–	1	–
7+	2.31	1.69–3.16	2.50	1.88–3.39
Age				
<10	1.13	0.46–2.76	0.73	0.23–2.29
10–64	2.81	1.57–5.04	2.21	1.21–4.01
65+	1 (ref)	–	1 (ref)	–

3.3. Patient with low back pain

There were an estimated 49 million patients with complaint of LBP. Their mean age was 42, 6% were pediatric (<19 years old), 59% were female. Children (age < 10, 40%) and older adults (65+ years of age, 34%) were less likely to be male compared to teens and adults <65 (42%) ($p < 0.001$). Compared to all other types of ED visits, LBP patients were less likely to have Medicaid as their expected source of payment (27% vs. 31%, $p < 0.001$). They were also more likely to be self-payers (21% vs. 17%, $p < 0.001$). Of all LBP visits, 51% occurred after hours (4 PM to 8 AM), and 26.6% occurred on weekends.

A pain score was reported in 83% of the LBP patients, of these, 72% had a severe level of pain at presentation (7 or higher). Females were slightly more likely to report severe pain (73% vs. 71%, $p = 0.14$). Severe pain for patients with LBP by age showed an inverted U shaped pattern with young children (age < 10) least likely to report severe pain, followed by older adults (>65) and teens/adults (40%, 63%, and 74%, respectively, $p < 0.001$). In a multivariate model including age and gender, only age was significantly related to severe pain. Teens/adults were more likely to report severe LBP than children or the elderly as shown in Table 1.

Of all LBP patients, 59% received an analgesic in the ED including opioids (40%), NSAIDS (29%), acetaminophen (4%), muscle relaxants (3%), and/or an anesthetic (1%). There were no time trends in the administration of analgesics or opioids in the ED over the study period (Fig. 1). Age and gender were not associated with receiving an analgesic in the ED, however, age was related to opioid use with children less likely to receive an opioid than teens/adults and the elderly (22% vs. 39% and 47%, respectively, $p < 0.001$). Severe pain was positively associated with receiving an analgesic with 47% of patients with a pain score of

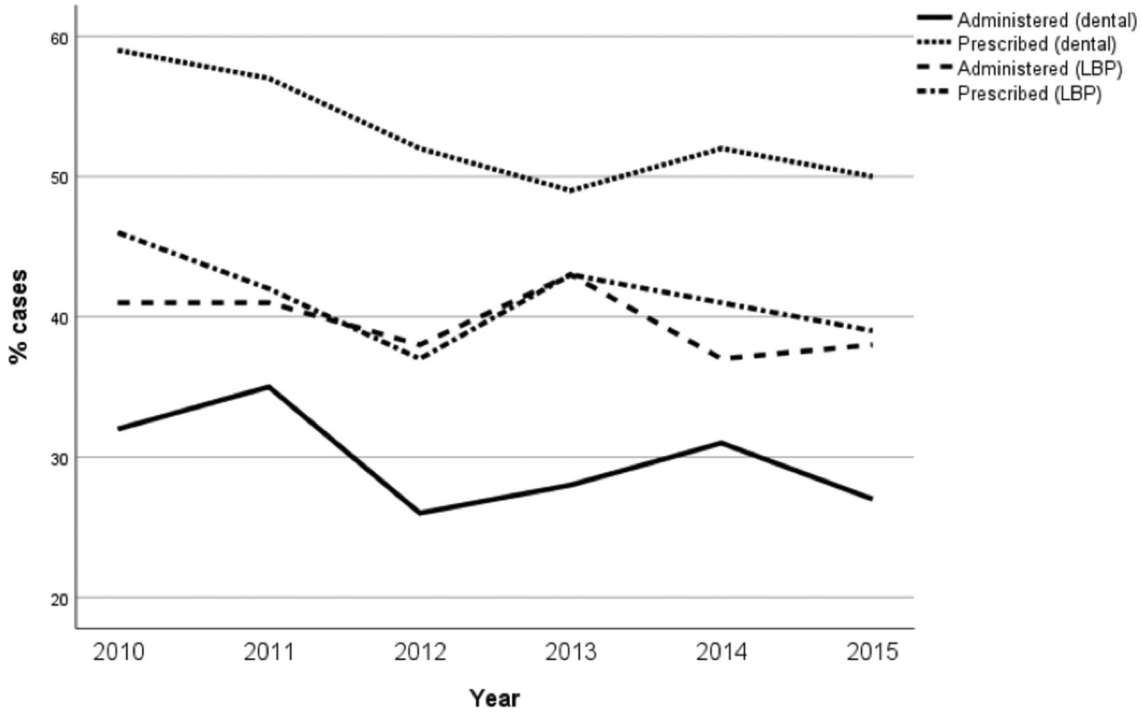

Fig. 1. Time trends of administering and prescribing of opioids by pain location.

<7 receiving an analgesic compared to 66% of those with severe pain ($p < 0.001$). Similarly, opioid administration was associated with severe pain with 27% of less severe pain patients receiving opioids compared to 47% of those with severe pain. In both the northeast and the south 36% of patients received an opioid in the ED, while 44% and 45% of patients in the midwest and west, respectively, received opioids ($p < 0.001$).

Multivariate analysis indicated that only severe pain was related to receiving an analgesic in the ED. However, children were less likely to receive opioids than teens/adults, who were in turn less likely to receive opioids than elderly patients. Patients with severe pain were more likely to receive opioids than those with less severe pain shown in Table 3.

For patients with LBP, 56% of patients were prescribed an analgesic prior to leaving the ED including NSAIDS (26%), opioids (41%), acetaminophen (5%), muscle relaxants (2%), and/or an anesthetic (0.3%). There was no time trend in prescribing analgesics but there was a slight downward trend in prescribing opioids, from 46% in 2010 to 39% in 2015 ($p = 0.09$). Males were more likely to get an analgesic prescription (59% vs. 54% for females, $p = 0.001$) and more likely to get an opioid prescription (43% vs. 40%, $p = 0.0008$). Age showed an inverted U shape pattern with both analgesic prescription and opioid prescription (both $p < 0.001$). Severe pain was associated with both prescribing any analgesia (61% vs. 51%, $p < 0.001$) and opioid prescribing (46% vs. 33%, $p < 0.001$). Opioid prescribing was less prevalent in the northeast (33%) compared to other regions of the country (41%, 43%, 44% in the Midwest, south, and west, respectively, $p = 0.001$). In a multivariate model gender, age, and severe pain were associated with both prescribing analgesics and opioid prescribing (Table 3).

3.4. Comparison of dental and low back pain patients

A comparison between ED patients presenting with dental or low back pain is presented in Table 4. In multivariate analysis gender was not associated with receiving any analgesic or receiving an opioid in the ED (Table 5). Age was related to opioids but not overall analgesia. Pain severity was associated with receiving any analgesic and receiving an opioid. Compared to patients with LBP, dental patients were less likely to receive analgesics or opioids while in the ED.

In multivariate analysis of prescribing patterns, gender was associated with being prescribed any analgesic at ED discharge but not with an opioid (Table 6). Age was related to both opioids and overall analgesic prescription. Pain severity was associated with prescription of any analgesic and opioids. Compared to patients with LBP, dental patients were more likely to have analgesics or opioids prescribed at the time of ED discharge.

Table 3
Multivariate association of pain severity and age with administration or prescription of analgesics or opioids to patients with low back pain.

Factor	Any analgesia given in ED		Opioid analgesia given in ED	
	OR	95% CI	OR	95% CI
Pain score				
<7	1 (ref)	–	1 (ref)	–
7+	2.18	1.85–2.57	2.44	2.07–2.88
Age				
<10	–	–	0.31	0.13–0.75
10–64	–	–	0.62	0.51–0.75
65+	–	–	1 (ref)	–
Factor	Any analgesia prescribed		Opioid analgesia prescribed	
	OR	95% CI	OR	95% CI
Pain score				
<7	1 (ref)	–	1 (ref)	–
7+	1.46	1.25–1.70	1.76	1.50–2.07
Age				
<10	1.37	0.68–2.76	0.82	0.36–1.84
10–64	2.54	2.04–3.16	1.82	1.46–2.26
65+	1 (ref)	–	1 (ref)	–
Gender				
Female	0.82	0.70–0.96	–	–
Male	1 (ref)	–	–	–

Table 4
Comparison of Dental and Low Back Pain Patients.

	Dental pain	Low back pain	P value
Year			0.18
Gender			<0.001
Male	48%	41%	
Female	52%	59%	
Age			<0.001
<10	7%	1%	
10–64	91%	86%	
65+	3%	13%	
Pain			0.07
<7	25%	28%	
7+	75%	72%	
Analgesic in ED			<0.001
No	56%	41%	
Yes	44%	59%	
NSAID in ED			<0.001
No	86%	71%	
Yes	14%	29%	
Opioid in ED			<0.001
No	70%	60%	
Yes	30%	40%	
Analgesic prescribed			<0.001
No	36%	44%	
Yes	64%	56%	
NSAID prescribed			<0.001
No	89%	74%	
Yes	11%	26%	
Opioid prescribed			<0.001
No	47%	59%	
Yes	53%	41%	

4. Discussion

Our results demonstrate a reduction in the prescription of opioids at the time of ED discharge for patients with dental pain but not LBP during the study period. No similar time trends were noted for the administration of opioids while in the ED for either patients with dental pain or those with LBP.

This study is based on a nationally representative sample and shows that when comparing patients with dental pain to patients with LBP, patients with dental pain are less likely to receive analgesics and opioids while in the ED (44% and 30% compared to 59% and 40% respectively). However, compared to patients with LBP, patients with dental pain are more likely to receive a prescription for analgesics and opioids upon discharge from the ED (64% and 53% compared to 56% and 41%

Table 5
Association of pain severity, age, and pain location with administration of analgesics or opioids.

Factor	Any analgesia given in ED		Opioid analgesia given in ED	
	OR	95% CI	OR	95% CI
Pain score				
<7	1 (ref)	–	1 (ref)	–
7+	2.16	1.88–2.46	2.40	2.10–2.75
Age				
<10	–	–	0.39	0.20–0.78
10–64	–	–	0.64	0.53–0.77
65+	–	–	1 (ref)	–
Condition				
Dental	0.51	0.44–0.59	0.65	0.57–0.74
LBP	1 (ref)	–	1 (ref)	–

Table 6
Association of pain severity, gender, age, and pain location with prescription of analgesics or opioids at ED discharge.

Factor	Any analgesia prescribed from ED		Opioid analgesia prescribed from ED	
	OR	95% CI	OR	95% CI
Pain score				
<7	1 (ref)	–	1 (ref)	–
7+	1.62	1.41–1.87	1.88	1.63–2.18
Gender				
Female	0.85	0.75–0.98	–	–
Male	1 (ref)	–	–	–
Age				
<10	0.97	0.46–2.04	0.54	0.23–1.26
10–64	2.09	1.72–2.53	1.50	1.24–1.81
65+	1 (ref)	–	1 (ref)	–
Condition				
Dental	1.32	1.16–1.51	1.65	1.47–1.85
LBP	1 (ref)	–	1 (ref)	–

respectively). For both conditions the greatest predictor for receiving analgesia or opioid medication was reporting severe pain. Of note, the percentages of patients reporting severe pain among those with dental pain and LBP were similar (75% and 72% respectively). While there were no regional differences in ED administration and prescription at discharge of opioids for patients with dental pain, use of opioids, both in the ED and at discharge, in patients with LBP was generally less in the Northeast region.

There are several possible explanations for the differences in the rates of administration of analgesics and opioids while still in the ED and the rates of prescription of the same agents at the time of ED discharge between patients with dental and lower back pain. For dental patients, their pain is often due to a preventable, underlying condition that requires definitive treatment by a dental professional [1,2]. These patients often do not have routine dental care, with Medicaid and uninsured patients over-represented in this population [2]. Due to the lack of ability to pay for routine checkups and definitive care, these patients often do not seek care until their pain reaches an unbearable level. These patients also often present during weekends and non-working hours for dentists offices [12]. In our study, we also found that most patients with dental complaints presented outside of normal business hours. This presents a unique problem for emergency providers. They often can't treat the underlying condition because emergency departments often do not staff dental professionals. Thus, they can only control the pain until the patient seeks definitive care. It should also be noted that it is likely that many patients are aware that the ED will be unable to provide definitive care, and that they specifically come seeking pain relief [13]. If said patient reports during hours where a dentist office isn't open the emergency provider may feel inclined to give the patient a prescription that will be able to last them long enough for them to get an appointment or otherwise risk the patient coming back to the ED for more pain control. Conversely for patients with LBP, after any serious underlying etiology is ruled out, the underlying cause is often self-limiting [14]. However, the pain often impairs the patient's mobility [14]. Due to the lack of mobility, emergency providers may be more likely to administer LBP patients analgesics and opioids while still in the ED in order to control their pain enough to be able to ambulate and discharge them and may be less inclined to prescribe analgesics or opioids outside of the hospital knowing the pain will be self-limiting.

These results support the idea that lack of access to definitive dental care can have various possible implications [15]. Most notably, it can potentially lead to an increase in opioid prescriptions and the risk of unintentional overdoses [16]. This is a particularly relevant topic given the recent rise in opioid addiction and overdoses throughout the country [17]. Opioid and heroin overdose has become the leading cause of accidental death [17]. Increased rates of opioid prescription are a risk factor for addiction and subsequently overdose, and this has prompted the CDC to release new guidelines regarding opioid prescription in order to minimize their use [18].

Emergency medicine practitioners should consider providing analgesic approaches that do not involve opioid prescriptions, or minimize the need for opioids. This may be accomplished by optimizing pain control while the patient is in the ED to break the cycle of pain, therefore making it easier for the patient to manage their pain while waiting for definitive care with NSAIDs and/or acetaminophen and any opioids that are still necessary can be minimized. This may be accomplished through the use of opioids, anti-inflammatory medications, local anesthetics, or a combination of the former while in the ED.

5. Limitations

Our study has several limitations. Most notable is the retrospective study design. This may have introduced bias due to inadequate or incorrect original medical record charting or data entering by the data abstractors. In addition, due to the limited data set, we cannot account for multiple potential confounding variables, such as prior use of analgesics or opioids, presence of contraindications to various medications, or patient preferences that may have affected choice of analgesia administration and prescription. The data in our study is limited to the years 2010–2015. It is possible that patterns of administration and prescription of analgesics and opioids in the ED may have changed in more recent years due to public attention and efforts to reduce opioid use [6,7]. Between 2010 and 2015 additional data was available in the NHAMCS, specifically the number of listed diagnoses was increased from 3 to 5 and the number of medications given in the ED and prescribed was increased to 30. Therefore, it is possible that some underreporting of the number of dental and LBP patients and their medications occurred for the earlier years. It is widely appreciated that there are significant delays before guidelines are translated into changes in clinical practice.

6. Conclusions

Our study demonstrates that there was a reduction in opioid prescriptions upon ED discharge for patients with dental pain and a similar trend for those with LBP between 2010 and 2015. It also indicates that patients with dental pain are more likely to be prescribed opioids at the time of ED discharge than patients with LBP of similar severity. Nationally, there has been an increase in the number of ED visits for patients with dental pain, and a high proportion of these patients receive prescriptions for opioid medications upon discharge. Use of non-opioid alternatives to manage patients with dental pain and LBP should be considered.

Appendix 1. Reason for visit codes used to identify study patients

RFV code	Definition
19050	Back symptoms
19051	Back pain, ache, soreness, discomfort
19052	Back cramps, contractures, spasms
19053	Limitation of movement, stiffness of back
19054	Weakness of back
19055	Swelling of back
19056	Lump, mass, tumor of back
19100	Low back symptoms
19101	Low back pain, ache, soreness, discomfort
19102	Low back cramps, contractures, spasms
19103	Limitation of movement, stiffness of lower back
19104	Weakness of lower back
19105	Swelling of lower back
19106	Lump, mass, tumor of lower back
51100	Sprain and strain of back
55150	Injury, other and unspecified of back

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