

## ORIGINAL ARTICLE

## Conservative Dentistry

# Opioid abuse/dependence among those hospitalized due to periapical abscess

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## Abstract

**Aim:** Opioid abuse/dependence (OAD) is an emerging public health crisis in the USA. The aim of the present study was to estimate the nationwide prevalence of OAD in those hospitalized due to periapical abscess in the USA.

**Methods:** The Nationwide Inpatient Sample for 2012-2014 was used. All patients who were hospitalized due to periapical abscess were selected for analysis. In this cohort, OAD was identified and used as the outcome variable. A mix of patient and geographic factors were used as independent variables. The simultaneous association between outcome and independent variables was examined by a multivariable logistic regression model. Clustering of outcomes within hospitals was adjusted. Odds of OAD were computed for all independent variables.

**Results:** During the study period, 30 040 patients were hospitalized due to periapical abscess; 1.5% of these had OAD. Those aged 18-29 years (odds ratio [OR] = 3.69, 95% confidence interval [CI] = 1.76-7.72,  $P < 0.01$ ) and 30-44 years (OR = 3.19, 95% CI = 1.77-5.76,  $P < 0.01$ ) were associated with higher odds for OAD compared to those aged 45-64 years. Blacks were associated with lower odds for OAD compared to whites (OR = 0.52, 95% CI = 0.28-0.95,  $P = 0.03$ ). Those covered by Medicare (OR = 4.08, 95% CI = 1.458-11.44,  $P = 0.01$ ), Medicaid (OR = 5.86, 95% CI = 2.22-15.47,  $P < 0.01$ ), and those who were uninsured (OR = 3.68, 95% CI = 1.30-10.45,  $P = 0.01$ ) were associated with higher odds for OAD compared to those covered by private insurance. The odds of OAD increased with comorbid burden (OR = 1.66, 95% CI = 1.50-1.84,  $P < 0.01$ ).

**Conclusions:** High-risk groups that are likely to have OAD were identified among those hospitalized due to periapical abscess.

## KEYWORDS

abscess, opioid epidemic, opioid abuse, prescription, periapical abscess

## 1 | INTRODUCTION

Over the past few decades, there has been an alarming increase in the number of opioid prescriptions dispensed, and an accompanying rise

in opioid-related overdoses and overdose-related deaths.<sup>1</sup> Opioids were the third most frequently dispensed class of medications in the USA in 2010, and were responsible for approximately \$8.4 billion in pharmaceutical sales.<sup>2,3</sup> A nationwide study in 2009 demonstrated

that, in the USA, primary care physicians accounted for 28.8% of opioids prescribed, internists accounted for 14.6%, and dentists accounted for 8% of opioids prescribed and were the primary prescribers of opioid medications for patients between the ages of 10 and 19 years.<sup>4</sup> Moreover, 99.9% of opioids dispensed by dentists are immediate-release opioid medications,<sup>5</sup> the most frequently abused class of opioids when compared to extended-release opioids. On average, oral surgeons prescribe 20 opioid pills following tooth extraction.<sup>6</sup> In 2011, there were 136.7 million medications containing hydrocodone, an immediate-release opioid,<sup>7</sup> making it the most prescribed medication in the USA, even surpassing medications used to manage chronic disease, such as simvastatin or levothyroxine.<sup>8</sup> Notably, the USA consumes 99% of the world's hydrocodone supply and 80% of its opioid supply, despite comprising only 4.6% of the world's population.<sup>9</sup> This indicates that the opioid abuse crisis is unique to the USA health-care system and not a crisis worldwide.

Opioid abuse in the USA has reached epidemic proportions, and the rate of overdose-related deaths continues to rise. In 2008, 36 450 people died due to overdose, which was four times the amount in 1999.<sup>10</sup> Similarly, the sales of opioid prescription drugs in 2008 were four times higher than that in 1999,<sup>10</sup> despite the fact that combination drugs consisting of non-steroidal anti-inflammatory drugs and acetaminophen were found to be safer and more effective for post-extraction pain.<sup>11</sup> A study of Medicaid patients between 2000 and 2010 examined a large cohort of patients in the USA and found that, within the first week after tooth extraction, 42% of opioids were filled by patients, and there was a threefold increase in the amounts of oral morphine prescribed between the 10th and 19th percentiles.<sup>6</sup> The highest proportion of filled prescriptions was for patients aged between 14 and 17 years of age (61%), followed by patients aged between 18 and 24 years (52%).<sup>6</sup> Furthermore, young adults between the ages of 18 and 26 years, who comprise approximately 19.6% of the population, had the highest rates of illicit drug use.<sup>9</sup>

When a patient presents with emergent pain, the dentist has two alternatives. First, make arrangements and accommodate the patient as soon as possible, even though it might mean compromising the treatment schedule planned on other patients that day. Second, prescribe an antibiotic or an analgesic for the patient until they can be accommodated. Alternatively, a patient who cannot access a dentist could present to the hospital emergency department (ED) with dental pain. Research has shown that >1.3 million ED visits per year are attributable to dental conditions.<sup>12</sup> Unfortunately, these ED visits do not result in definitive care, and research suggests that 56% of them result in opioid prescription and 52% result in antibiotic prescription.<sup>13</sup>

Prescribing opioids can also be subsequent to a dental appointment. As mentioned earlier, research has shown that only 42% of dental patients filled their opioid prescription 7 days after a dental extraction, which could suggest overprescribing by dentists.<sup>6</sup> Currently, dentists across the USA are not required to register and participate in a prescription drug-monitoring program (PDMP)

before prescribing opioids; however, this is set to change.<sup>14</sup> The utilization of a PDMP could facilitate addiction screening and referral, as well as better coordination of care.

To date, there are no nationally representative estimates of opioid abuse/dependence (OAD) estimates in those admitted primarily due to periapical abscess. The objective of the present study was to estimate the nationwide prevalence of OAD in those hospitalized due to periapical abscess in the USA, and to examine factors associated with OAD in this cohort of hospitalizations. We hypothesized that a mix of patient- and geography-related factors is associated with OAD in this cohort.

## 2 | MATERIALS AND METHODS

### 2.1 | Description of database

The Nationwide Inpatient Sample (NIS) for 2012-2014 was used for the present study.<sup>15</sup> The NIS is the largest all-payer in-hospital admissions database in the USA, and is sponsored by the Agency for Healthcare Research and Quality (AHRQ) through the Healthcare Cost and Utilization Project (HCUP). The NIS is a 20% sample of all hospitalizations that occur in the USA annually. Each hospitalization in the NIS database is assigned a sample weight, and this can be used to project to nationally representative estimates of all hospitalizations occurring in the USA. Over 100 data elements are available in the database. The NIS database has been validated extensively and used widely for examining hospitalization outcomes, inpatient care utilization trends, and for health economics/policy/outcomes research.

### 2.2 | Institutional review board approval

The present study used a database that is available from purchase from AHRQ-HCUP following completion of a data user agreement. All individual records are de-identified of any unique patient identifiers. As the present study was a retrospective analysis of already existing de-identified data, an "exempt" status was obtained from the Office of Human Subjects Protection. The data user agreement with AHRQ-HCUP precludes researchers from reporting individual cell counts of  $\leq 10$ . Consequently, such low numbers are not presented in the present study.

### 2.3 | Case selection

All patients who were hospitalized due to periapical abscess were selected for analysis. International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes of 522.5 (periapical abscess without involving sinus) and 522.7 (periapical abscess with involvement of sinus) in the primary diagnosis field (reason for hospitalization) were used for identifying the patients hospitalized due to periapical abscess.<sup>16</sup>

**TABLE 1** Characteristics of patients hospitalized due to periapical abscess

Characteristic	Hospitalizations (%) Total = 30 040
Type of periapical abscess	
Without sinus involvement	97.1
With sinus involvement	2.9
Opioid abuse or dependence	
Yes	1.5
No	98.5
Age (years)	
≤17	17.3
18-29	19.1
30-44	26.1
45-64	26.7
≥65	10.8
Sex	
Male	47.3
Female	52.7
Type of admission	
Emergency/urgent	94.3
Elective	5.7
Race (information on race available for 2270 hospitalizations)	
White	59.8
Black	21.4
Hispanic	13.7
Asian/Pacific Islander	1.4
Native American	0.7
Other races	2.9
Household income levels	
Quartile 1 (lowest 25% in nation)	36.9
Quartile 2	26.4
Quartile 3	21.4
Quartile 4 (highest 25% in nation)	15.2
Comorbid burden	
0	37.1
1	24.6
2	15.3
3	10.9
4	6.5
5	3.3
6	1.4
≥7	0.8
Insurance status	
Medicare	18.7
Medicaid	31.2
Private	26
Uninsured	20.5
Other insurance	3.7

## 2.4 | Outcome variable

The outcome variable of interest in the present study was a diagnosis of OAD. ICD-9-CM codes for OAD in the secondary diagnoses fields (29 fields) were used to identify patients with a diagnosis of OAD. The codes included opioid-type dependence (opioid-type dependence: heroin, meperidine, methadone, morphine, opium, opium alkaloids and their derivatives, synthetics with morphine-like effects) codes of 304.00 (unspecified), 304.01 (continuous), 304.02 (episodic), and 304.03 (in remission); and opioid abuse codes of 305.50 (unspecified), 305.51 (continuous), 305.52 (episodic), and 305.53 (in remission). A composite binomial variable was created for every patient as having or not having OAD.

## 2.5 | Independent variables

A mix of patient (age; sex; race; type of admission; comorbid burden, as computed from the NIS disease severity files; household income quartiles based on zip codes; and insurance status), geographic factors (geographic region of residence of patient and urban/rural location of hospital), and hospital type (teaching or non-teaching, and hospital bed size) were used as independent variables.

## 2.6 | Analytical approach

The simultaneous association between outcome and independent variables was examined by a multivariable logistic regression model. Clustering of outcomes within hospitals was adjusted. Odds of OAD were computed for all independent variables. Variances were computed using the Taylor linearization method using a “with replacement” design. NIS stratum was the stratification variable, while the unit of analysis was each hospitalization. All statistical tests were two sided, and a *P*-value of <0.05 was deemed to be statistically significant. All statistical tests of associations were conducted using SAS Callable SUDAAN version 11.0.1 software (Research Triangle Institute, Research Triangle, NC).

## 3 | RESULTS

During the study period (2012-2014), 30 040 patients were hospitalized due to periapical abscess across the USA. The descriptive characteristics of this cohort are presented in Table 1. Those aged 30-44 years and 45-64 years comprised of 26.1% and 26.7% of the patients, respectively. Close to 53% of all patients were females. Most patients (94.3%) were admitted to hospital as inpatients on emergency or urgent bases. Whites (59.8%) were the most frequently hospitalized, followed by blacks (21.4%) and Hispanics (13.7%). Close to 37% of patients resided in geographic areas that were designated as having the lowest household income quartile levels. Approximately 37% of patients did not have

**TABLE 2** Geographic region and hospital characteristics

Region/characteristic	Hospitalizations (%) Total=30 040
Geographic region	
Northeast	18.6
Midwest	24.7
South	37.7
West	18.9
Hospital location/teaching status	
Rural	9.1
Urban non-teaching	28.2
Urban teaching	62.7
Hospital bed size	
Small	15.2
Medium	24.9
Large	59.9

a concomitant comorbid condition. The frequently reported insurance payers included Medicaid (31.2%), Medicare (18.7%), private insurance plans (26%), and other insurance plans (3.7%); 20.5% of patients did not have any medical insurance, and 1.5% of patients hospitalized due to periapical abscess were diagnosed as having OAD.

The geographic and hospital characteristics of those hospitalized due to periapical abscess are summarized in Table 2. The southern region accounted for 37.7% of all hospitalizations, followed by the Midwest (24.7% of hospitalizations). Most admissions were to urban teaching hospitals (62.7%). Close to 60% of admissions occurred in large bed-size hospitals.

A summary of estimates from the multivariable logistic regression model where the characteristics associated with a patient having OAD is given in Table 3. Those aged 18-29 years (odds ratio [OR] = 3.69, 95% confidence interval [CI] = 1.76-7.72,  $P < 0.01$ ) and 30-44 years (OR = 3.19, 95% CI = 1.77-5.76,  $P < 0.01$ ) were associated with higher odds for OAD compared to those aged 45-64 years. Those aged  $\geq 65$  years were associated with lower odds for having OAD (OR = 0.15, 95% CI = 0.03-0.64,  $P = 0.01$ ) when compared to those aged 45-64 years. Sex was not significantly associated with OAD. Blacks were associated with lower odds for OAD compared to whites (OR = 0.52, 95% CI = 0.28-0.95,  $P = 0.03$ ). Those covered by Medicare (OR = 4.08, 95% CI = 1.45-11.44,  $P = 0.01$ ), Medicaid (OR = 5.86, 95% CI = 2.22-15.47,  $P < 0.001$ ), other insurance plans (OR = 8.10, 95% CI = 2.38-27.52,  $P < 0.001$ ) and those who were uninsured (OR = 3.68, 95% CI = 1.30-10.45,  $P = 0.01$ ) were associated with higher odds for OAD compared to those covered by private insurance. The odds of OAD increased with comorbid burden (OR = 1.66, 95% CI = 1.50-1.84,  $P < 0.01$ ). There were no significant variations in OAD across geographic regions of the USA and by hospital location/teaching status. Household income levels were not significantly associated with OAD.

**TABLE 3** Characteristics associated with opioid abuse/dependence

Characteristic	Odds ratio (95% confidence interval)	P-value
Age of patient (years)		
$\geq 17$	0.23 (0.03-2.04)	0.19
18-29	3.69 (1.76-7.72)	$<0.001$
30-44	3.19 (1.77-5.76)	$<0.001$
$\geq 65$	0.15 (0.03-0.64)	0.01
45-64	Reference	
Sex		
Female	0.77 (0.49-1.24)	0.28
Male	Reference	
Race		
Black	0.52 (0.28-0.95)	0.03
Hispanic	0.52 (0.21-1.30)	0.16
Asian/Pacific Islander	DNC	-
Native American	DNC	-
Other races	DNC	-
White	Reference	
Insurance status		
Medicare	4.08 (1.45-11.44)	0.01
Medicaid	5.86 (2.22-15.47)	$<0.001$
Uninsured	3.68 (1.30-10.45)	0.01
Other insurance	8.10 (2.38-27.52)	$<0.001$
Private insurance	Reference	
Income quartiles		
Quartile 1 (lowest 25% in nation)	1.19 (0.58-2.46)	0.63
Quartile 2	0.97 (0.45-2.08)	0.94
Quartile 3	0.82 (0.37-1.83)	0.62
Quartile 4 (highest 25% in nation)	Reference	
Comorbid burden		
Each 1 unit increase	1.66 (1.50-1.84)	$<0.001$
Year of hospitalization		
2013	1.00 (0.57-1.77)	0.99
2014	1.35 (0.79-2.31)	0.28
2012	Reference	
Geographic region		
Northeast	1.19 (0.55-2.56)	0.66
Midwest	0.82 (0.42-1.60)	0.56
South	0.71 (0.37-1.36)	0.30
West	Reference	
Location/teaching status of hospital		
Urban teaching hospital	1.59 (0.95-2.66)	0.08
Urban non-teaching/rural hospitals	Reference	

DNC, model did not converge because of too few events in these subgroups.

## 4 | DISCUSSION

In the present study, we used a nationally representative database of all hospitalizations to examine the prevalence of OAD in a cohort of patients hospitalized due to periapical abscess in the USA during 2012-2014. To our knowledge, this is the first report at a national level. The current study identified several high-risk groups that are more likely to have OAD among the cohort that was hospitalized primarily due to periapical abscess. Identifying high-risk groups is the first step toward developing intervention strategies tailored to the needs of these high-risk individuals. A study published in 2016 examined the pattern of opioid prescriptions, and was the first assessment of the amount of unused opioids containing analgesics following dental surgery.<sup>17</sup> Specifically, the proportion of the opioids left unused by the patient was investigated, and a behavioral intervention was performed to assess if it had an impact on patient willingness to properly dispose leftover opioid medications at a pharmacy-based drug disposal program. Although not a statistically-significant finding, when patients were given one sheet of educational information and a small economic incentive, 22% of patients reported that they disposed or intended to dispose of the opioids at the pharmacy-based drug disposal. Effective programs such as this could reduce the availability of opioids and reduce the incidence of OAD.

The current study demonstrated that 1.5% of patients who are hospitalized due to periapical abscess also have a diagnosis of opioid abuse/dependence. Previous research has demonstrated that one in every 550 chronic opioid user dies within approximately 2.5 years of their first opioid prescription.<sup>18</sup> Opioids are a powerfully addictive and dangerous class of drugs, and prescribing it must be done with great caution.

In 2014, a study examined the prevalence of opioid analgesic misuse in adults who were patients at dental school clinics to assess the proportion of patients who reported non-medical use of prescription pain medications and to screen for associated patient characteristics.<sup>19</sup> Approximately 37.9% of patients reported non-medical use of their prescription pain medications within the past 30 days, with 23.6% taking more than prescribed, 18.9% took medications that were "borrowed", 17.3% taking pain medications that belonged to somebody else, and 15.5% took the pain medications for reasons other than for pain relief. Medication diversion was reported by 6.5% of respondents who reported either selling, trading, or giving away their prescription pain medications to someone else. A significant relationship existed in patients reporting non-medical use of prescription pain medication, also admitting that they divert their medications. Additional research has demonstrated that 54% of opioids prescribed by a dental surgery are not used, which creates a large amount of tablets that might circulate and be used for a purpose they are not prescribed for.<sup>17</sup>

The current study demonstrates that the odds of being hospitalized due to periapical abscess and having a concurrent diagnosis of

opioid abuse/dependence is much higher for those with Medicaid, Medicare, and the uninsured when compared to those who are privately insured. Research by Ameritox (a drug-testing and medication-monitoring company), that was not published in a peer-reviewed journal, showed that 17% of Medicaid patients tested positive for an illegal drug compared to 9.7% who had private insurance.<sup>20</sup>

ProPublica is an independent investigative journalism group, which also conducted a study that did not appear in a peer-reviewed journal, but demonstrated that opioid use among Medicare beneficiaries has been on the rise.<sup>21</sup> The current paper is the first large-scale study to confirm this trend in a peer-reviewed journal.

The federal government mandates state Medicaid to provide dental coverage for children up to the age of 18 years.<sup>22</sup> However, after 18 years, there can be a gap in coverage for many who rely on government insurance. Similarly, the Affordable Care Act mandated that privately-insured individuals could remain on their parents' dental insurance until the age of 26 years.<sup>23</sup> Once again, beyond the age of 26 years, there could be a gap in coverage. It is notable that the ages of 18-26 years could represent lapses in dental insurance coverage. Such individuals might neglect their dental care, and previous research has shown that a larger proportion of uninsured and Medicaid-covered individuals might present to the hospital ED with a dental complaint.<sup>12</sup> In the current study, we considered individuals hospitalized due to periapical abscess, and demonstrated that, compared to 45-64 year olds, there are higher odds of OAD among 18-44 year olds, and particularly 18-29 year olds.

The present study results are subject to several limitations and these should be taken into consideration when interpreting the findings. Our study is a retrospective analysis of a nationwide hospitalization database. With retrospective analyses, a true "cause-and-effect" relationship cannot be attributed, and only "associations" can be discerned. The mix of independent variables we used to examine association with OAD was limited to the availability of data elements in the NIS database. Consequently, there could be a host of several other factors (ie behavioral factors) that are not captured in the database that could be associated with OAD. Despite the above limitations, the present study findings add much to the existing literature on OAD. The findings from the present study are externally valid, generalizable, and represent the problem on a national scale.

It is important to provide patients in the dental clinic with information, especially for those patients with heightened risk of misuse or abuse, regarding how to properly store, use, and dispose of any unused opioid medications. Several strategies are being adopted to help health-care professionals avoid prescription drug abuse. These include screening patients for substance abuse prior to prescribing opiates, educating patients about how to properly dispose of unused prescription opioids and to never share them, preventing "doctor shopping" by using a PDMP to track patients who could be at risk of overdosing or misusing prescription opioids, and making sure to prescribe the smallest quantity to manage the patient's acute pain.<sup>24</sup>

## 4.1 | Conclusions

High-risk groups that are likely to have OAD were identified among those hospitalized due to periapical abscess. Ages 18-29 years, individuals covered by Medicaid insurance, individuals from regions with the lowest income quartile, and those with increasing comorbid burden were identified in the present study as having a higher risk for OAD among those hospitalized due to periapical abscess.

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