

DR. ROMESH P NALLIAH (Orcid ID : 0000-0002-6287-0656)

Article type : Original Article

MS SUB HEAD # CONSERVATIVE DENTISTRY

Opioid Abuse/Dependence among those Hospitalized Due to Periapical Abscess

**Deepti Shroff¹, Romesh P. Nalliah BDS MHCM², Veerajalandhar Allareddy MD MBA³,
Sangeetha Chandrasekaran BDS MS⁴, Kyle Stein DDS FACS⁵, Sankeerth Rampa MBA
PhD⁶, Veerasathpurush Allareddy BDS PhD⁷**

1 – DMD student, Harvard School of Dental Medicine, Boston, MA 02115

2 – Associate Professor, Department of Cariology, Restorative Sciences and Endodontics, School of Dentistry – University of Michigan, Ann Arbor, MI 48109

3 – Associate Professor, Stead Family Department of Pediatrics, University of Iowa, Iowa City, IA 52241

4 – Associate Professor, Department of Surgical Dentistry, School of Dental Medicine - University of Colorado Anschutz Medical Campus, Aurora CO 80045

5 – Assistant Professor, Department of Oral and Maxillofacial Surgery, College of Dentistry and Dental Clinics – The University of Iowa, Iowa City, IA 52241

This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the [Version of Record](#). Please cite this article as [doi: 10.1111/jicd.12354](https://doi.org/10.1111/jicd.12354)

This article is protected by copyright. All rights reserved

6 – Assistant Professor, Health Care Administration Program, School of Business – Rhode Island College, Providence, RI 02908

7 – Professor and Director of Clinical Research, Department of Orthodontics, College of Dentistry and Dental Clinics – The University of Iowa, Iowa City, IA 52241

Key words: Periapical abscess, opioid abuse, pain, access to care, abscess

Number of words in abstract: 239

Number of words in manuscript: 2955

Number of tables: 3

Number of figures: 0

Number of references: 23

Conflict of interest: None to Declare

Presentation: Results from the study were accepted to be presented at the 47th Annual Meeting of the American Association of Dental Research held in Ft. Lauderdale (March 2018).

Funding source: None

Address correspondence:

Romesh P. Nalliah

Director of Clinical Education for DDS Program

Office of Patient Services

University of Michigan School of Dentistry

Ann Arbor, MI, 48109

Email: romeshn@umich.edu

Tel: 734-615-8057

ABSTRACT

Objective: Opioid abuse/dependence (OAD) is an emerging public health crisis in the USA. Objective of this study is to estimate the nationwide prevalence of OAD in those hospitalized due to periapical abscess in the USA.

Methods: The Nationwide Inpatient Sample for years 2012 to 2014 was used. All patients that were hospitalized due to periapical abscess were selected for analysis. In this cohort, OAD was identified and used as the outcome variable. 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 was 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 to 29 years (OR=3.69, 95%CI=1.76-7.72, $p<0.01$) and aged 30 to 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 to 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 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. Odds of OAD increased with co-morbid 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 amongst those hospitalized due to periapical abscess.

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 deaths¹. Opioids were the third most frequently dispensed class of medications in the United States in 2010, and were responsible for approximately \$8.4 billion in pharmaceutical sales^{2,3}. A nationwide study in 2009 demonstrated that in the United States, Primary care physicians accounted for 28.8% of opioids prescribed, Internists accounted for 14.6 percent, and Dentists accounted for 8% of opioids prescribed and were the primary prescribers of opioid medications for patients between the ages of 10 and 19⁴. Moreover, 99.9% of opioids dispensed by Dentists are immediate-release opioids medications⁵, the most frequently abused class of opioids when compared to extended-release opioids. On an average, oral surgeons prescribe 20 opioid pills following tooth extraction⁶. In 2011, there were 136.7 million medications containing hydrocodone, an immediate-release opioid⁷, making it the most prescribed medication in the United States, even surpassing medications used to manage chronic disease such as simvastatin or levothyroxine⁸. Notably, the United States consumes 99% of the world's hydrocodone supply and 80% of its opioid supply despite comprising only 4.6 percent of the world's population⁹. This indicates that the opioid abuse crisis is unique to the United States healthcare system and not a crisis worldwide.

Opioid abuse in the United States 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 1999¹⁰. Similarly, the sales of opioid prescription drugs in 2008 were four times higher than that in 1999¹⁰, 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 pain¹¹. A study of Medicaid patients between 2000 and 2010 examined a large cohort of patients in the United States 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 percentiles⁶. The highest proportion of filled prescriptions was in patients between 14 and 17 years of age (61%) followed by patients between 18 and 24 years (52%)⁶. Furthermore, young adults between the ages of 18

and 26 years, who comprise of approximately 19.6% of the population, had the highest rates of illicit drug use⁹.

When a patient presents with emergent pain, the dentist has two alternatives. Firstly, make arrangements and accommodate the patient as soon as possible though it may mean compromising the treatment schedule planned on other patients that day. Secondly, prescribe an antibiotic or an analgesic for the patient until they can be accommodated. Alternatively, a patient who cannot access a dentist may present to the hospital emergency department (ED) with dental pain. Research has shown that over 1.3 million ED visits per year are attributable to dental conditions¹². Unfortunately, these ED visits do not result in definitive care and research suggests that 56% of them result in opioid prescription and 56% result in antibiotic prescription¹³.

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 may suggest overprescribing by dentists⁶. Currently, dentists across the United States are not required to register and participate in a prescription drug monitoring program (PDMP) before prescribing opioids, however, this is set to change.¹⁴ Utilization of a PDMP may facilitate addiction screening and referral as well as better coordination of care.

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

MATERIALS AND METHODS

Description of Database: The Nationwide Inpatient Sample (NIS) for years 2012 to 2014 was used for the present study.¹⁵ The NIS is the largest all-payer in-hospital admissions database in the United States 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 United States 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 United States. Over 100 data elements are available in the database. The NIS database has been validated extensively and used widely for examining hospitalization outcomes, in-patient care utilization trends, and for health economics/policy/outcomes research.

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. Since, the present study is 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 ≤ 10 . Consequently, such low numbers are not presented in this study.

Case Selection: All patients that were hospitalized due to periapical abscess were selected for analysis. 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.¹⁶

Outcome Variable: The outcome variable of interest in the present study was a diagnosis of Opioid abuse/dependence (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); 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.

Independent Variables: A mix of patient (age, sex, race, type of admission, co-morbid burden as computed from the NIS disease severity files, house hold 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.

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 was 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).

RESULTS

During the study period (years 2012 to 2014), a total of 30,040 patients were hospitalized due to periapical abscess across the entire United States. The descriptive characteristics of this cohort are presented in table 1. Those aged 30 to 44 years and those aged 45 to 64 years comprised of 26.1% and 26.7% of the patients. Close to 53% of all patients were females. A vast majority of

patients (94.3%) were admitted as in-patients into the hospital on emergency or urgent basis. 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. About 37% of patients did not have a concomitant co-morbid 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. 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 Midwest (24.7% of hospitalizations). Majority of admissions were into Urban Teaching hospitals (62.7%). Close to 60% of admissions occurred in large bed size hospitals.

Summary of estimates from the multivariable logistic regression model where the characteristics associated with a patient having OAD are summarized in table 3. Those aged 18 to 29 years (OR=3.69, 95%CI=1.76-7.72, $p<0.01$) and aged 30 to 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 to 64 years. While those aged 65 years and above 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 to 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 the 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. Odds of OAD increased with co-morbid 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 United States and by hospital location/teaching status. Household income levels were not significantly associated with OAD.

DISCUSSION

The present study used a nationally representative database of all hospitalizations to examine the prevalence of OAD in a cohort of patients that were hospitalized due to periapical abscess in the United States during the years 2012 to 2014. To our knowledge, this is the first report at a national level. The current study identified several high risk groups who are more likely to have OAD in the cohort that are hospitalized primarily due to periapical abscess. Identifying high risk groups is the first step towards 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 opioid containing analgesics following dental surgery¹⁷. 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 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 has shown 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 1 of

every 550 chronic opioid users die within approximately 2.5 years of their first opioid prescription¹⁸. 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 screen for associated patient characteristics¹⁹. 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 belong to somebody else and finally, 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 may circulate and be used for a purpose they were not prescribed for¹⁷.

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 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 insurance²⁰.

ProPublica is an independent investigative journalism group and they 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 rise²¹. 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 18²². However, beyond the age of 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 26²³. 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 may represent lapses in dental insurance coverage. Such individuals may neglect their dental care and previous research has shown a larger proportion of uninsured and Medicaid covered individuals may present to the hospital ED with a dental complaint¹². The current study considered individuals hospitalized due to periapical abscess and demonstrates that, compared to 45-64 year olds, there are higher odds of opioid abuse/dependence 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 while 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 opioid abuse/dependence was limited to the availability of data elements in the NIS database. Consequently, there could be a host of several other factors (like behavioral factors) that are not captured in the database that could be associated with opioid abuse/dependence. Despite the above limitations, the present study findings add much to the existing literature on opioid abuse/dependence. 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 the 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 healthcare 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 never share them, preventing “doctor shopping” by using a prescription drug monitoring program to track patients who may be at risk of overdosing or misusing prescription opioids, and making sure to prescribe the smallest quantity to manage the patient’s acute pain²⁴.

CONCLUSIONS

High risk groups that are likely to have OAD were identified amongst 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 co-morbid burden were identified by this study as having a higher risk for OAD amongst those hospitalized due to periapical abscess.

REFERENCES

1. Chen LH, Hedegaard H, Warner M. Drug-poisoning Deaths Involving Opioid Analgesics: United States, 1999-2011. NCHS Data Brief 2014(166):1-8.
2. Nash DB. The use of medicines in the United States: a detailed review. Am Health Drug Benefits 2012;5(7):423.
3. Ahmedani BK, Peterson EL, Wells KE, Lanfear DE, Williams LK. Policies and events affecting prescription opioid use for non-cancer pain among an insured patient population. Pain Physician 2014;17(3):205-16.
4. Volkow ND, McLellan TA, Cotto JH, Karithanom M, Weiss SR. Characteristics of opioid prescriptions in 2009. Jama 2011;305(13):1299-301.
5. McCauley JL, Hyer JM, Ramakrishnan VR, et al. Dental opioid prescribing and multiple opioid prescriptions among dental patients: Administrative data from the South Carolina prescription drug monitoring program. J Am Dent Assoc 2016;147(7):537-44.
6. Baker JA, Avorn J, Levin R, Bateman BT. Opioid Prescribing After Surgical Extraction of Teeth in Medicaid Patients, 2000-2010. Jama 2016;315(15):1653-4.
7. Denisco RC, Kenna GA, O'Neil MG, et al. Prevention of prescription opioid abuse: the role of the dentist. J Am Dent Assoc 2011;142(7):800-10.

8. Manchikanti L, Helm S, 2nd, Fellows B, et al. Opioid epidemic in the United States. *Pain Physician* 2012;15(3 Suppl):Es9-38.
9. Manchikanti L, Fellows B, Ailinani H, Pampati V. Therapeutic use, abuse, and nonmedical use of opioids: a ten-year perspective. *Pain Physician* 2010;13(5):401-35.
10. Prevention CfDca. Vital signs: overdoses of prescription opioid pain relievers---United States, 1999--2008. *MMWR Morb Mortal Wkly Rep* 2011;60(43):1487-92.
11. Moore PA, Hersh EV. Combining ibuprofen and acetaminophen for acute pain management after third-molar extractions: translating clinical research to dental practice. *J Am Dent Assoc* 2013;144(8):898-908.
12. Allareddy V, Rampa S, Lee MK, Allareddy V, Nalliah RP. Hospital-based emergency department visits involving dental conditions: profile and predictors of poor outcomes and resource utilization. *J Am Dent Assoc* 2014;145(4):331-7.
13. Sun BC, Chi DL, Schwarz E, et al. Emergency department visits for nontraumatic dental problems: a mixed-methods study. *Am J Public Health* 2015;105(5):947-55.
14. Haffajee RL, Jena AB, Weiner SG. Mandatory use of prescription drug monitoring programs. *JAMA*. 2015 Mar 3;313(9):891-2.
15. Healthcare Cost and Utilization Project (HCUP) AHRQ: The National (Nationwide) Inpatient Sample (NIS) for years 2012 to 2014. 2017.
16. Prevention CDC International Classification of Diseases,Ninth Revision, Clinical Modification (ICD-9-CM). "<https://www.cdc.gov/nchs/icd/icd9cm.htm>". Accessed 6th Mar 2014.
17. Maughan BC, Hersh EV, Shofer FS, et al. Unused opioid analgesics and drug disposal following outpatient dental surgery: A randomized controlled trial. *Drug Alcohol Depend* 2016;168:328-34.
18. Gomes T, Juurlink DN, Antoniou T, et al. Gabapentin, opioids, and the risk of opioid-related death: A population-based nested case-control study. *PLoS Med* 2017;14(10):e1002396.
19. Ashrafioun L, Edwards PC, Bohnert AS, Ilgen MA. Nonmedical use of pain medications in dental patients. *Am J Drug Alcohol Abuse* 2014;40(4):312-6.

20. Report NP Medicaid Patients More Likely To Use Illegal Drugs.
["http://nationalpainreport.com/medicaid-patients-more-likely-to-use-illegal-drugs-8815665.html"](http://nationalpainreport.com/medicaid-patients-more-likely-to-use-illegal-drugs-8815665.html). Accessed Jan 2018.
21. Charles Ornstein RGJ As Controlled Substance Use Rises in Medicare, Prolific Prescribers Face More Scrutiny Propublica: 2014.
["https://www.propublica.org/article/as-controlled-substance-use-rises-in-medicare-top-prescribers-face-scrutiny"](https://www.propublica.org/article/as-controlled-substance-use-rises-in-medicare-top-prescribers-face-scrutiny). Accessed 1/23 2018.
22. McGinn-Shapiro M Medicaid Coverage of Adult Dental Services. National Academy for State Health Policy 2008.
["http://www.usalliancefororalhealth.org/sites/default/files/reports/Adult%20Dental%20Monitor.pdf"](http://www.usalliancefororalhealth.org/sites/default/files/reports/Adult%20Dental%20Monitor.pdf). Accessed January 23 2018.
23. Healthcare.Gov How to get or stay on a parent's plan. HealthCare.gov: U.S. Centers for Medicare & Medicaid Services. ["https://www.healthcare.gov/young-adults/children-under-26/"](https://www.healthcare.gov/young-adults/children-under-26/). Accessed January 23 2018.
24. Pon D, Awuah K, Curi D, Okyere E, Stern CS. Combating an Epidemic of Prescription Opioid Abuse. J Calif Dent Assoc 2015;43(11):673-8.

Table 1. Characteristics of Patients Hospitalized Due to Periapical Abscess

Characteristic		% of Hospitalizations (Total N = 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	Up to 17 years	17.3%
	18 to 29 years	19.1%
	30 to 44 years	26.1%
	45 to 64 years	26.7%
	65 years and above	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 28,270 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%
Co-morbid 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%

Table 2. Geographic Region and Hospital Characteristics

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

Table 3. Characteristics Associated with Opioid Abuse/Dependence

Characteristic		Odds Ratio (95% CI)	p-value
Age of patient	Up to 17 years	0.23 (0.03 – 2.04)	0.19
	18 to 29 years	3.69 (1.76 – 7.72)	<0.001
	30 to 44 years	3.19 (1.77 – 5.76)	<0.001
	65 years and above	0.15 (0.03 – 0.64)	0.01
	45 to 64 years	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	
Co-morbid 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

Author Manuscript