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Primary Payer Status is Associated with the Use of Nerve Block Placement for Ambulatory Orthopedic Surgery

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Abstract

Introduction—Although more than 30 million patients in the United States undergo ambulatory surgery each year, it remains unclear what percentage of these patients receive a perioperative nerve block. We reviewed data from the 2006 National Survey of Ambulatory Surgery (NSAS) to determine the demographic, socioeconomic, geographic, and clinical factors associated with the likelihood of nerve block placement for ambulatory orthopedic surgery. The primary outcome of interest was the association between primary method of payment and likelihood of nerve block placement. Additionally, we examined the association between type of surgical procedures, patient demographics, and hospital characteristics with the likelihood of receiving a nerve block.

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Methods—This cross-sectional study reviewed 6,000 orthopedic anesthetics from the 2006 NSAS dataset, which accounted for over 3.9 million orthopedic anesthetics when weighted. The primary outcome of this study addressed the likelihood of receiving a nerve block for orthopedic ambulatory surgery according to the patient's primary method of payment. Secondary endpoints included differences in demographics, surgical procedures, side effects, complications, recovery profile, anesthesia staffing model, and total perioperative charges in those with and without nerve block.

Results—Overall, 14.9% of anesthetics in this sample involved a peripheral nerve block. Length of time in postoperative recovery, total perioperative time, and total charges were less for those receiving nerve blocks. Patients were more likely to receive a nerve block if their procedures were performed in metropolitan service areas (OR 1.86, 95% CI 1.19-2.91, p=0.007) or freestanding surgical facilities (OR 2.27, 95% CI 1.74-2.96, p<0.0001), and if payment for their surgery was supported by government programs (OR 2.5, 95% CI 1.01-6.21, p=0.048) or private insurance (OR 2.62, 95% CI 1.12-6.13, p=0.03) versus self-pay or charity care.

Conclusion—For patients receiving ambulatory orthopedic surgery in the United States, our results suggest that geographic and socioeconomic factors are associated with different likelihoods of perioperative peripheral nerve block placement.

Introduction

The number of outpatient surgery visits in the United States increased over the past decade and now account for nearly two-thirds of all surgery visits. In 2006, 3.9 million ambulatory orthopedic surgical procedures accounted for more than 15% of all performed outpatient surgeries.* Although perioperative pain management for ambulatory orthopedic patients imposes a substantial challenge, an increasing number of studies have reported benefits of multimodal analgesia that include the use of a variety of regional techniques.[1] Among others, peripheral nerve blocks have been shown to improve pain control, minimize postoperative nausea and vomiting, improve patient satisfaction, and result in shorter hospital stays following ambulatory orthopedic surgery.[2-4] However, factors associated with the likelihood of peripheral nerve block use for ambulatory orthopedic surgery in the United States remain insufficiently studied, at least partially due to the lack of a comprehensive and representative national sample database related to outpatient surgical procedures.

The introduction of National Survey of Ambulatory Surgeries (NSAS) by the Centers for Disease Control and Prevention in 1996 provided a unique representative national data set that included information regarding the type of anesthesia and analgesia used during ambulatory surgery, along with patient demographic, socioeconomic, and medical information.† Because NSAS uses complex sampling designs with well-defined sampling and weighting strategy, it is uniquely positioned to explore associations between socioeconomic factors and nerve block use for ambulatory surgery while providing national estimates).† NSAS was recently used to characterize the types of ambulatory pediatric anesthetics administered in the United States, as well as the use of monitored anesthesia care for ambulatory surgery.[5,6] Although lack of health insurance or underinsured status is associated with poor outcomes after multiple types of surgery, the potential role of socioeconomic factors, such as the primary method of payment, on the likelihood of regional anesthesia use and nerve block placement started to emerge only recently.[7,8] It is conceivable that socioeconomic factors may alter the likelihood of nerve block use for

* Cohen RA, Martinez ME, Free HL. Health insurance coverage: early release of estimates from the National Health Interview Survey, Centers for Disease Control and Prevention, 2007. http://www.cdc.gov/NCHS/data/nhis/earlyrelease/insur200806.htm

†Cullen KA, Hall MJ, Golosinskiy A. Ambulatory surgery in the United States, 2006. National Health Statistics Reports. National Center for Health Statistics, 2009.http://www.cdc.gov/nchs/data/nhsr/nhsr011.pdf

ambulatory orthopedic surgery. Despite concerns about increased time requirements for block placement , the improvement in postoperative analgesia with regional anesthetics may increase the perceived value of regional anesthesia over opioid-based therapies for postoperative pain relief among anesthesia providers.[9-11] Despite the possible cost-savings attributable to nerve block use for ambulatory orthopedic surgery, prior work has demonstrated that cost sensitivity may not be properly considered in decisions regarding perioperative workflow.[12-16]

The goal of this study was to determine, using the NSAS as representative national data set, whether demographic and socioeconomic factors were associated with the likelihood of nerve block placement for ambulatory orthopedic surgery in the United States.

Methods

The National Survey of Ambulatory Surgery Data Set

This study was approved by the Institutional Review Board at the University of Florida. We used the 2006 NSAS data set with age-correction updates that were applied in 2010. The NSAS is a publicly available data set that complements the National Hospital Discharge Survey to account for the surgical procedures performed on an outpatient basis. The NSAS data set was designed to assist with a “variety of planning, administrative and evaluation activities by government, professional, scientific, academic, and commercial institutions, as well as by private citizens.” (http://www.cdc.gov/nchs/nsas/about_nsas.htm) The database is created as a result of the CDC-funded sample survey that collected data from 142 hospitals and 295 freestanding ambulatory surgical centers, each performing at least 50 ambulatory surgical procedures in the year 2006. The sampling frame was developed from the “Hospital Market Index” and Freestanding Outpatient Surgery Center Database, as published by Verispan, LLC. Facilities were sampled using a two-stage, list-based sample design, stratified by type of facility, facility specialty, and geographic region. Facilities specifically focused on dentistry, podiatry, pregnancy termination, family planning, or birthing were excluded from the sample. In the first stage of the design, systematic random sampling of facilities was employed with probabilities proportional to the annual number of ambulatory surgeries conducted at each facility. In the second stage of the survey design, the sample of ambulatory surgery visits at each facility was selected via systematic random sampling. Visit selection was performed separately for each intra-facility location where ambulatory procedures were conducted. No geographic information on the location of ambulatory surgical centers, other than location within the United States, was available from the NSAS data set. Additionally, the data set contained no variables concerning ambulatory surgical volume per facility; thus, controlling for preferential sampling of high-volume facilities was not possible. (http://www.cdc.gov/nchs/nsas/nsas_sample_design.htm).

Sampling and data abstraction were performed by staff at the sampled facility and by employees of the U.S. Census Bureau functioning under the National Center for Health Statistics (NCHS) as part of the NSAS database creation. Approximately 40% of the sampling and 30% of the data abstractions were conducted by facility-specific staff. The remainder of data was collected by the NCHS/U.S. Bureau personnel. Independent recoding of approximately 10% of abstracts were performed by a private corporation, with discrepancies resolved by a chief coder, for quality control purposes. The overall error rate for the data set included 0.3% for diagnosis coding, 0.2% for procedure coding, and 0.3% for demographic coding (http://www.cdc.gov/nchs/nsas/nsas_collection.htm).

The multistage area probability designs of NSAS include clustering, stratification, and the assignment of unequal probabilities of selection to sample units. NSAS provides sampling weights for each case to derive national estimates and to calculate the corresponding sampling errors while taking into account the complex sampling design.

Case Selection, Outcome and Covariates

Cases involving orthopedic surgical procedures as a primary or secondary procedure in the data set (using International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM] 9 procedural code groups 77.13-84.3) were included in analysis. None of the selected surgical procedures precluded nerve block placement on the basis of the surgical procedure itself. The primary outcome was the likelihood of receiving a peripheral nerve block as part of the anesthetic management for ambulatory orthopedic surgery. Separate binary-input data fields were available for different types of anesthesia (eg, general anesthesia, nerve block, IV sedation, monitored anesthesia care, etc.), allowing multiple types of anesthetics to be flagged for each case. Due to the heterogeneity of definitions concerning "regional anesthesia" and "block" and the need to employ a binary outcome for the stratified and weighted logistic regression, we grouped anesthetic types into those specifically flagged for "regional block" versus those not flagged specifically for "regional block." A copy of the medical abstract used to collect information for the 2006 NSAS can be found at http://www.cdc.gov/nchs/data/hdasd/nsas_participant/nsas5.pdf.

The primary covariate of interest was primary payer status. We encountered no missing values in the data set for the primary covariate. Patients were stratified by primary payer status into 3 comparison groups: government-supported insurance (Medicare, Medicaid, TriCare, or other government), private insurance (worker's compensation, private or commercial insurance), and self-pay/charity care (self-pay, charity care/write off, no charge or other) as previously described.[7]

Depending on the primary procedure, cases were categorized into 6 surgical groups according to International Classification of Diseases, Ninth Revision, Clinical modification (ICD-9-CM) procedural code categories: Incision or excision of bones, fracture or dislocation repair, repair of muscles or fascia, upper extremity joint repair, lower extremity joint repair, and other (Appendix 1, Supplemental Digital Content 1, http://links.lww.com/AAP/A46). These groups were generated based on broad criteria for level of nociception, potential use of nerve blocks, and by upper versus lower extremity to improve the granularity over those groupings offered by the Healthcare Cost and Utility Project (HCUP) Procedure Classes. Details on the number of diagnoses, procedures, perioperative time, and charges were analyzed as continuous variables. Information regarding the location of the facility in either a metropolitan or non-metropolitan service area and free-standing versus hospital-based status of the facility were included in the dataset. Zip codes or other information that specified geographic location were not included.

Patient comorbid disease was computed using the Charlson-Deyo Comorbidity Index by weighting and summing comorbidities represented by ICD-9-CM codes for 6 diagnoses provided for each case in NSAS. The Charlson-Deyo Comorbidity Index was developed using hospital emergency department admissions with 1-year mortality and was modified by Deyo et al to apply coding algorithms for administrative hospital discharge data with ICD-9-CM codes.[17, 18]

Statistical Analysis

The complex design of sample surveys like NSAS dictates that the data analysis procedure is able to account for multiple stages of sampling, stratification, and clustering causing the assignment of unequal probabilities of selection to sample units. The complexity of non-random sample surveys causes a departure from the assumption that independent sample points have equal probabilities of selection. Therefore, specially-designed procedures are required to accurately compute estimates of population statistics and their standard errors; otherwise, the standard errors produced, as in a simple random sample, would generally underestimate the true population value, negating the validity of resulting confidence intervals or statistical significance tests.[19]

We used specialized statistical software (PROC SURVEYMEANS, SURVEYLOGISTIC and SURVEYFREQ procedures, SAS version 9.2, SAS Institute Inc, Cary, North Carolina) that utilizes the Taylor series linearization method to estimate population characteristics from NSAS sample survey data. In all analyses, we applied sampling weights provided in the NSAS to generate national estimates. The PROC SURVEYLOGISTIC regression procedure was used to model the probability of nerve block placement as a function of primary payment status as a primary covariate, adjusted for other relevant demographic, socioeconomic and clinical factors while incorporating complex survey sample design of NSAS, including stratification, clustering, and unequal weighting. Odds ratios for covariates obtained from the survey logistic regression were reported, as was the C-statistic, equivalent to the area under the receiver operating curve, for the model itself. We used the adjusted Wald test statistic for model fit, as recommended for the survey logistic regression analysis.[20] To test for co-linearity, we performed serial removal of each variable in the survey logistic model, resulting in minimal fluctuations in the values of remaining regression coefficients, thus minimizing the role of collinearity.[19] The statistical significance for all tests was predetermined at 0.05.

Results

The complete NSAS data set contained a total of 52,233 observations for 2006. The subset data set pertaining to orthopedic surgical procedure consisted of 6,387 sampled observations, and when weighted, accounted for more than 3.9 million ambulatory orthopedic surgeries in the United States (Appendix 1, Supplemental Digital Content 1, http://links.lww.com/AAP/A46). Overall, 14.9% of all anesthetic use involved a peripheral nerve block (Table 1). The use of nerve blocks was commonly combined with monitored anesthesia care, intravenous sedation, and general anesthesia, but rarely with neuraxial anesthetics (Appendix 2).

In the univariate analysis, no statistically significant difference was observed for gender, discharge disposition, emergency department (ED) visits, or hospital admissions via the ED when comparing those patients receiving and not receiving a nerve block. The majority of subjects in both the nerve block and no-nerve block groups listed private or commercial insurance as their primary method of payment (Table 1).

The majority of patients had no known comorbidities, as reflected by a Charlson-Deyo Comorbidity Index (CCI) of 0, regardless of the use of nerve block or primary payer status. The presence of uncomplicated diabetes was not associated with nerve block placement (1.7% without nerve block vs. 2.5% with nerve block, p=0.4). Similar results were obtained for patients with diabetic complications (0.3% without nerve block, 0.1% with nerve block, p=0.06) (Table 1). Notably, there were differences in the proportion of patients with uncomplicated diabetes according to primary payer status (3% for government-sponsored, 1.4% for private, and 0.4% for charity care, p=0.0002) (Table 2).

Patients receiving nerve blocks had fewer diagnoses (1.8, 95% CI 1.72-1.95 versus 2, 95% CI 1.92-2.04 for patients not receiving a nerve block, p=0.03) but received more procedures on the day of surgery (2.1, 95% CI 2-2.3 versus 1.9, 95% CI 1.87-1.96, p=0.0007). Duration of surgery and total operating room time were similar whether or not a nerve block was placed. However, the postoperative recovery time was significantly less in those patients receiving a nerve block, as was the total perioperative time. The total charges for surgery were less for those patients receiving a nerve block. (Table 3)

In the multivariate regression model, the primary method of payment significantly affected the likelihood of receiving a nerve block in this sample (overall model p<0.001, C-statistic 0.702) (Table 4). When compared with self-pay or charity care, government-supported sources of payment were 2.5 (OR 2.5 95% CI, 1.01-6.21) times more likely to receive a nerve block. Similarly, patients reporting private insurance were 2.6 (OR 2.6, 95% CI 1.12-6.13) times more likely to receive a nerve block when compared with self-pay or charity care. Fracture or dislocation repair (OR 3.03, 95% CI 1.6-5.74), repair of muscles or fascia (OR 3.9, 95% CI 2.34-6.49), and upper extremity joint repair (OR 4.6, 95% CI 2.78-7.61) increased the odds of a peripheral nerve block compared with other types of surgery. Metropolitan service area increased the likelihood of a nerve block compared with non-metropolitan areas, as did free-standing versus hospital-based surgical centers. Age, gender, type of anesthesia care team model, number of surgical procedures, and length of surgery did not affect the chance of receiving a nerve block in a statistically-significant manner.

Discussion

For patients undergoing orthopedic ambulatory surgery, the likelihood of receiving a nerve block was significantly affected by the primary method of payment. Type of surgery, case complexity, and type and location of surgical center also influenced the likelihood of nerve block placement for ambulatory orthopedic surgery. Considering that the weighted estimate of annual orthopedic ambulatory surgeries in this model reached over 3.9 million, even small differences between these groups may be considerably magnified when viewed with a national perspective.

Those subjects included in the 2006 NSAS data set exhibited a low rate of comorbid conditions according to the Charlson-Deyo Comorbidity Index. This low rate was observed across both types of payment and placement of nerve block placement. This likely reflects the younger and healthier population more likely to receive surgery at an ambulatory surgical facility. Patients with particular conditions, such as diabetes, may be less likely to receive regional anesthetics due to concerns about nerve injury; such comorbid conditions may also be associated with lower socioeconomic status.[21-24] Our data actually demonstrated a higher rate of diabetes among patients with government-sponsored primary method of payment, although the presence of diabetes was not associated with the use or avoidance of a nerve block.

The lack of an association between CCI score and nerve block use contrasts with our findings demonstrating an association between nerve block use and fewer concomitant diagnoses. It is possible that the diagnoses were related to the orthopedic injury necessitating surgery rather than comorbid medical conditions. The association between nerve block use and an increased number of procedures may reflect errors in the method of description inherent to ICD-9-CM procedural codes, or it may indicate that nerve blocks were more likely to be used in more extensive surgical procedures.

Although prior work has suggested associations between type of anesthetic and primary method of payment for inguinal hernia repair, our results suggest that such associations may be more widespread.8 The odds of receiving a nerve block more than doubled for those patients with government-supported or private insurance, even after controlling for all other listed effects in our model. These results complement our findings suggesting that metropolitan centers were more likely than their rural counterparts to place nerve blocks, as were freestanding surgical centers over mixed-volume, hospital-based ambulatory surgeries. With more than 43 million uninsured Americans in 2006,* this may represent a substantial difference in anesthetic care based upon socioeconomic and geographic factors. This difference becomes more interesting when one considers that many anesthesiologists and surgeons would request a nerve block for their own surgery, and that ambulatory surgery involving peripheral nerve block may lead to decreased costs of care.[10,11,25]

Interpretation of these results would be greatly enhanced by inclusion of data concerning the level of education among patients and providers, because the above results could be significantly confounded. Although isolating patient preferences may be difficult even in prospective data collection, training background and geographic location of practice may also shed light on the effect of surgeon and anesthesiologist preference for nerve blocks. Together, the preferences of patients, surgeons, and anesthesiologists, coupled with the practice patterns of local healthcare systems, may offer alternative reasons for the use of nerve blocks for ambulatory orthopedic surgery.

Regardless of the true benefits and detriments of nerve blocks, the relative increase in use in the insured populations raises the possibility that perioperative nerve blocks carry a perceived value-additive effect. That is, nerve blocks are placed with the assumption that they improve the care of ambulatory surgical patients. Such decisions may be evidence-based or simply reflect the belief of the practicing anesthesiologist. Because no information concerning the type, effect, timing, or even indication of the nerve block is available in the NSAS data set, we were unable to control for the appropriateness of nerve block use. Conversely, the possibility of block placement in order to receive additional reimbursement from insured patients cannot be ruled out.

Our results do not necessarily suggest intentional modification of anesthetic plans according to primary method of payment at the provider level. Rather, the observed associations may reflect anesthetic practices and/or protocols inherent to a given perioperative healthcare system. Such an explanation would concurrently explain the additional associations between location and type of surgical facility with the use of peripheral nerve blocks for ambulatory orthopedic surgery. Although geographic data would further highlight the contribution of regional anesthetic practice patterns, this information was not available in the NSAS data set.

The lack of a difference in provision of nerve blocks between men and women and across different age groups is notable, given the noted differences in pain characterization and response across age and gender.[26-28] Nonetheless, patients receiving nerve blocks had similar surgical times yet still had slightly less recovery room time, according to univariate analysis. We speculate that this may suggest improvements in the recovery profile. Although such conclusions are limited by the nature of univariate analytic methods, the reduction in recovery time is similar to prior findings that reported shortened hospital stays for patients receiving peripheral nerve blocks.[15] Use of a nerve block was associated with lower charges for perioperative care; although this may be attributable to time savings from the nerve block, the coarse surgical grouping employed in this analysis renders such conclusions suspect because the cost differences may actually be correlated with differences in surgical procedure. This finding is nevertheless notable in light of the differences in nerve block use according to primary method of reimbursement.

Preoperative nerve blocks are commonly placed in either the general preoperative area, in a dedicated block room, or in the operating room prior to incision.[29, 30] Our results suggest that patients receiving nerve blocks had very similar surgical and total operating room (OR) times, but the results do not differentiate where nerve blocks were placed. The lack of a significant difference between surgical and OR times suggests nerve blocks are being routinely placed in a preoperative setting or expeditiously placed in the OR. Regardless, the data suggests that nerve blocks used for anesthesia in orthopedic surgical procedures do not routinely lead to more time in the operating room.

Our study suffered from weaknesses inherent to reviews of large federal databases. The orthopedic procedures examined in this study comprised only 12% of the total survey volume of procedures. The separation of anesthetics only by the presence or absence of a nerve block, separate from the use of differing levels of sedation and/or a neuraxial technique, was necessary to perform a weighted binary logistic regression. Additionally, the weighting and stratification methodology may lead to exaggerated or minimized effect during construction of statistical models. Thus, inclusion of weighting and stratification variables in the models may minimize such imbalances. The grouping of ambulatory orthopedic surgical procedures was necessary to avoid over-partitioning of surgical procedures. Such grouping inevitably leads to a loss of resolution in terms of the relationship between individual surgical procedures and the applicability of nerve blocks as a relevant anesthetic. Because the goal of this study was to examine the use of nerve blocks for ambulatory orthopedic surgery at a national scale, such a compromise was deemed acceptable. Future projects will be necessary to specifically target nerve block use in specific surgical procedures.

Retrospective cohort studies carry the potential for confounding, selection and information biases. As discussed, patient and provider education status, geography, localized practice patterns, and provider training background may each confound the association between primary payment methodology and nerve block use. Although our variables were restricted to those available in the NSAS data set, these associations were partly addressed through examination of facility type, rural versus urban location, and type of anesthetic care team. Further examination of confounders are needed to examine, either prospectively or through separate large-scale outcomes studies that link financial variables, geographic and training data, detailed patient demographics, and anesthetic practices. Concerns regarding selection bias were addressed during the NSAS data collection by employing stratified random sampling. Although comparing error rates in data collection and outcome assignment according to outcome level is not possible, the binary-nature of the outcome, along with the discrete method for data collection regarding peripheral nerve block, likely lessens the probability of information bias. Despite the potential for confounding bias, this work highlights the importance of prospective studies examining the role of socioeconomic factors in nerve block use to determine how best to optimize access to nerve blocks for patients who desire their benefits.

With more than 3 million Americans undergoing ambulatory orthopedic surgical procedures each year, interventions to improve care and decrease cost have significant ramifications. Our data suggest that socioeconomic and geographic factors may influence the likelihood of a patient receiving a peripheral nerve block. Further work is necessary to explore the impact of socioeconomic status and regional practice differences on peripheral nerve block use for ambulatory orthopedic surgery.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Appendix

Appendix 2:

Appendix 2

Use of Concomitant Anesthetics with and without Nerve Block

	Weighted Frequency	Row Percent
No Block		
Epidural	8,690	0.3
No Epidural	3,350,028	99.7
Spinal	88,237	2.6
No Spinal	3,270,481	97.4
General Anesthesia	2,389,840	71.2
No General Anesthesia	968,878	28.8
IV Sedation	583,949	17.4
No IV Sedation	2,774,769	82.6
MAC	576,811	17.2
No MAC	2,781,907	82.8
Block		
Epidural	1,498	0.3
No Epidural	586,040	99.7
Spinal	1,505	0.3
No Spinal	586,033	99.7
General Anesthesia	180,233	30.7
No General Anesthesia	407,305	69.3
IV Sedation	157,182	26.8
No IV Sedation	430,356	73.2
MAC	131,054	22.3
No MAC	456,484	77.7

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Table 1

Univariate analysis of patient, surgical and anesthetic factors associated with nerve block placement.

Variables	No Nerve Block	Nerve Block	P-value
N (weighted number)	3,358,718 (85.1)	587,538 (14.9)	<0.0001
Female (Weighted No., %)	1,737,721 (51.7)	269,751 (45.9)	<0.06
Age Group (Weighted No., %), years			<0.003
Under 15	206,897 (6.2)	8,204 (1.4)	
15-44	1,134,482 (33.8)	200,523 (34.1)	
45-64	1,437,054 (42.8)	269,330 (45.8)	
65 & Up	580,285 (17.3)	109,481 (18.6)	
Payment (Weighted No., %)			<0.02
Government (Medicare, Medicaid, Tricare, Other Gov.)	887738 (26.4)	144648 (24.6)	
Private or Commercial Insurance	2318933 (69)	433428 (73.8)	
Self-Pay, Charity Care, Write Off or No Charge	152047 (4.5)	9462 (1.6)	
Anesthesia Provider (Weighted No., %)			0.43
Anesthesiologist + CRNA	707,960 (21.1)	142,393 (24.2)	
Anesthesiologist Only	1,992,912 (59.3)	327,897 (55.8)	
Type of Orthopedic Surgery (Weighted No., %)[1]			<0.0001
Incision or Excision of Bones	526,478 (15.7)	53,898 (9.2)	
Fracture or Dislocation Repair	329,072 (9.8)	56,374 (9.6)	
Repair of Muscles or Fascia	467,812 (13.9)	116,443 (19.8)	
Upper Extremity Joint Repair	568,921 (16.9)	210,535 (35.8)	
Lower Extremity Joint Repair	959,727 (28.6)	115,521 (91.7)	
Other Orthopedic Procedure	506,708 (15.1)	34,767 (5.9)	
Surgical Facility Location (Weighted No., %)			<0.0001
Metropolitan Area	2,904,625 (86.5)	549,968 (93.6)	
Non-Metropolitan Service Area	454,093 (13.5)	37,570 (6.4)	
Facility Type (Weighted No., %)			<0.0001
Hospital-Based	2,067,672 (61.6)	208,685 (35.5)	
Freestanding	1,291,046 (38.4)	378,853 (64.5)	
Discharge Disposition (Weighted No., %)			0.32
Routine Discharge to Customary Residence	3,179,750 (94.7)	568,434 (96.7)	
Discharge to Observation Status	64,942 (1.9)	3,468 (0.6)	
Discharge to Post-Surgical/Recovery Care Facility	9,525 (0.3)	342 (0.1)	
Admitted to Hospital as Inpatient	26,818 (0.8)	2,725 (0.5)	
Follow-up (Weighted No., %)			
Patient Reported Problem on Follow-up	169,359 (5)	63,275 (10.8)	<0.0005
Patient Visited ED	5,609 (0.2)	804 (0.1)	0.86
Patient Admitted via ED	12,217 (0.4)	984 (0.2)	0.4

Variables	No Nerve Block	Nerve Block	P-value
Charlson Comorbidity Index (Weighted No., %)			
0	3203215 (95%)	561986 (96%)	
1	115149 (3%)	16983 (3%)	
2	37647 (1%)	8569 (1%)	
3	1080 (<1%)	0	
4	1627 (<1%)	0	
Charlson Comorbidity Index Diagnostic Groups (Weighted No., %)			
Congestive Heart Failure	3362 (0.1%)	0	
Diabetes, No Complications	57771 (1.7%)	14445 (2.5%)	0.4
Diabetes, with Complications	8506 (0.3%)	299 (0.1%)	0.06
COPD	34145 (1%)	5482 (0.9%)	0.9
Cerebrovascular Disease	2515 (0.1%)	0	
Rheumatoid and Connective Tissue Disease	14076 (0.4%)	3211 (0.6%)	0.6

[1] Type of orthopedic surgery classified according to ICD-9 procedure codes. Detailed description can be viewed in Addendum Table 1. Weighted numbers correspond to national estimates. Abbreviations: CRNA= Certified Registered Nurse Anesthetist; ED=Emergency Department; COPD = Chronic Obstructive Pulmonary Disease

Table 2

Associations between comorbidities and method of payment group

Variables	Government	Private	Charity	P-value
Charlson Comorbidity Index (Weighted No., %)				
0	960108 (93%)	2660033 (97%)	145060 (90%)	
1	50421 (5%)	77622 (2.8%)	4089 (2.5%)	
2	19150 (1.9%)	14706 (0.5%)	12360 (7.5%)	
3	1080 (<1%)	0	0	
4	1627 (<1%)	0	0	
Charlson Comorbidity Index Diagnostic Groups (Weighted No., %)				
Congestive Heart Failure	3362 (0.3%)	0	0	
Diabetes, No Complications	32771 (3%)	38761 (1.4%)	684 (0.4%)	0.002
Diabetes, with Complications	5041 (0.5%)	3764 (0.1%)	0	
COPD	11257 (1.1%)	26260 (1%)	2110 (1.3%)	0.9
Cerebrovascular Disease	1689 (0.2%)	826 (0.03%)	0	
Rheumatoid and Connective Tissue Disease	8352 (0.8%)	8935 (0.3%)	0	

*Moderate-Severe Liver Disease, Dementia = 0 events

Abbreviations: COPD = Chronic Obstructive Pulmonary Disease

Table 3

Case Complexity, Times and Costs for Patients With and Without Perioperative Nerve Block

	No Nerve Block Mean (95% CI)	Nerve Block Mean (95% CI)	P-value
Case Complexity			
Number of Diagnoses	2 (1.92-2.04)	1.8 (1.72-1.95)	0.03
Number of Procedures	1.9 (1.87-1.96)	2.1 (2-2.3)	0.0007
Times and Cost			
Length of Surgery (minutes)	46.9 (44.8-48.9)	46.7 (43.2-50.1)	0.93
Length of Time in Operating Room (minutes)	78.6 (75.3-81.8)	77.8 (72.7-83)	0.82
Length of Time in Post-Op (minutes)	85 (81.3-88.8)	74.5 (69.7-79.4)	<0.0001
Total Time (minutes)	167.3 (161.8-172.9)	155.8 (147.1-164.5)	<0.0001
Total Charges (dollars)	8,151.50 (7,418.45-8,884.55)	6,359.70 (5,638.63-7,080.77)	<0.0001

Table 4

Factors Associated with the Likelihood of Nerve Block Placement

Variables	Odds Ratio (OR) (95% Wald Confidence Intervals)	P-value
Demographic		
Age (per year)	1.01 (1.00-1.02)	0.07
Female Gender (reference Male)	0.82 (0.63-1.06)	0.13
Anesthesia Provider		
Anesthesiologist Only (reference Anesthesiologist + CRNA)	0.82 (0.58-1.17)	0.28
Coded CRNA Only (vs. Anesthesiologist + CRNA)	1.12 (0.73-1.71)	0.6
Type of Surgery		
Incision or Excision of Bones (vs. Other)	1.66 (0.92-2.99)	0.09
Fracture or Dislocation Repair (vs. Other)	3.03 (1.6-5.74)	0.0007
Repair of Muscles or Fascia (vs. Other)	3.9 (2.34-6.49)	<.0001
Upper Extremity Joint Repair (versus Other)	4.6 (2.78-7.61)	<.0001
Lower Extremity Joint Repair (versus Other)	1.51 (0.86-2.67)	0.15
Primary Method of Payment		
Government supported (vs. self-pay or charity care)	2.5 (1.01-6.21)	0.048
Private Insurance (vs. self-pay or charity care)	2.62 (1.12-6.13)	0.027
Facility Details		
Metropolitan Service Area (Yes vs. No)	1.86 (1.19-2.91)	0.007
Facility Type (Freestanding vs. hospital based)	2.27 (1.74-2.96)	<.0001
Case Complexity		
Number of Diagnoses	0.88 (0.78-0.99)	0.036
Number of Procedures	1.11 (0.99-1.25)	0.069
Length of Surgery (per minute)	1 (0.998-1.003)	0.87

Whole-Model p<0.0001, C-Statistic 0.702