THE ROLE OF SOCIOECONOMIC FACTORS IN THE UTILIZATION OF REGIONAL ANESTHESIA FOR AMBULATORY ORTHOPEDIC SURGERY

By

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A THESIS PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
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To my wife and daughters

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I thank my wife and daughters, my parents, and the numerous mentors and advisors who have offered their patience and time.

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LIST OF ABBREVIATIONS

CCI	Charlson Comorbidity Index
CDC	Centers for Disease Control and Prevention
CPT	Current procedural terminology
HCUP	Healthcare Cost and Utility Project
ICD-9-CM	International Classification of Diseases, 9^{th} Revision, Clinical Modification
NCHS	National Center for Health Statistics
NSAS	National Survey of Ambulatory Surgeries
OR	Odds ratio

Abstract of Thesis Presented to the Graduate School
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Although over 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.

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.

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. 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.

CHAPTER 1
INTRODUCTION

Peripheral nerve blocks are an important component of multimodal analgesic therapy aimed at decreasing postoperative pain. Aside from decreasing postoperative pain, nerve blocks can minimize postoperative nausea and vomiting, improve patient satisfaction, and lead to shorter hospital stays following surgery.[1]These benefits are especially important for patients undergoing ambulatory orthopedic surgery, where the presence of severe pain, nausea or vomiting may result in unexpected hospital admissions and prolonged recovery.[1]

In 2006, over 50 million surgical and nonsurgical procedures were performed during more than 34 million ambulatory surgery visits in the United States.[2] It remains unclear what percentage of these patients receive a nerve block as part of their anesthetic plan and postoperative analgesic regimen. Although the lack of health insurance or underinsured status is associated with the poor outcomes after multiple types of surgery,[3] the impact of patient factors, including primary method of payment, on the likelihood of nerve block placement for ambulatory orthopedic surgery has not been studied to date.

The National Survey of Ambulatory Surgeries (NSAS) is a unique representative national dataset in that it includes information related to the type of anesthesia and analgesia used during ambulatory surgery, along with patient demographic and financial information.[4] This survey has been used in prior efforts 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] Because the NSAS dataset contains explicit data fields indicating the use of a nerve block as well as financial, demographic, and procedural information, the NSAS is uniquely positioned to explore associations between socioeconomic factors and nerve block utilization for ambulatory surgery.

The use of peripheral nerve blocks for ambulatory anesthesia may require incremental increases in perioperative time requirements, thus increasing the cost of anesthetic care when used in conjunction with general anesthesia. The prolonged post-operative analgesia possible with regional anesthetics may impart an increased perceived value of regional anesthesia over opioid-based therapies for postoperative pain relief. In the United States, this is reflected in the separate billing procedure for nerve blocks used for postoperative pain control. It is feasible that, either through conscious or subconscious patient selection, or via access to anesthesiologists experienced in nerve block placement, regional anesthetic utilization may be thus modulated by primary payment method.

The goal of this study was to determine, using the NSAS database, whether demographic, socioeconomic, geographic, and clinical factors were associated with the likelihood of nerve block placement for ambulatory orthopedic surgery. We hypothesized that lack of insurance may alter the odds of receiving a peripheral nerve block for ambulatory orthopedic surgery. The primary outcome of interest was primary method of payment. Additionally, we examined the association between type of surgical procedures, patient demographics, and hospital characteristics with the likelihood of receiving a nerve block.

CHAPTER 2
METHODS

Description of the National Survey of Ambulatory Surgery

This study was approved by the Institutional Review Board at the University of Florida. The NSAS dataset is a publicly available dataset that complements the National Hospital Discharge Survey to account for the surgical procedures performed on an outpatient basis. Our study used the 2006 NSAS dataset with the age-correction updates that were applied in 2010. The NSAS dataset 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”.[4] This CDC-funded study collected data from 142 hospitals and 295 freestanding ambulatory surgical centers, each performing at least 50 ambulatory surgical procedures in the previous year, for 2006. The sampling frame was developed from the “Healthcare Market Index,” “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. Those 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 dataset. Additionally, the dataset contained no variables concerning ambulatory surgical volume per facility, and thus controlling for preferential sampling of high-volume facilities was not possible.

Sampling and data abstraction were performed by both staff at the sampled facility and 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 was 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).

Case Selection

Cases involving orthopedic surgical procedures as a primary or secondary procedure in the dataset (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.

Outcome Description

The primary outcome was the likelihood of receiving a peripheral nerve block as part of the anesthetic for ambulatory orthopedic surgery. Separate binary-input data fields were available for general anesthesia, nerve block, IV sedation, monitored anesthesia care, epidural, spinal, retrobulbar block, peribulbar block, regional block, other, and none specified. Multiple types of anesthetics could be flagged for each procedure. Due to the heterogenicity 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.

Description of Covariates

The primary covariate of interest was primary method of payment. The NSAS dataset contained discrete variables for primary, secondary and tertiary methods of payment. All subjects within the sample were assigned a primary payer status. The primary method of payment was grouped into three broad categories: 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) to avoid over-partitioning.

Additional covariates included in the analysis were type of surgical procedures and demographic and hospital characteristics. Depending on the primary procedure, cases were categorized into six surgical groups according to ICD-9 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). These groups were generated based upon broad criteria for level of nociception, potential use of nerve blocks, and by upper versus lower extremity in order to improve the granularity over those groupings offered by the Healthcare Cost and Utility Project (HCUP) Procedure Classes. Data for type of anesthesia provider was recoded into two groups: anesthesiologist only, and anesthesiologist with CRNA. No information on the level of training for each provider was available in the NSAS dataset. Details concerning the number of diagnoses, procedures, perioperative time, and charges were analyzed as continuous variables. Age and gender were included as part of the survey. Metropolitan service area and free-standing versus hospital-based status of the facility were included in the NSAS dataset.

Comorbidities were assessed using the Charlson Comorbidity Index (CCI).[7] The NSAS dataset included variables for encoding up to 6 diagnoses coded using the ICD-9-CM system. As previously described, we compiled a CCI score for each record using the 6 diagnostic codes available.[8] The CCI was entered as an additional covariate in the stratified logistic regression modeling.

We additionally compared the use of nerve block, and the primary payment methodology, with the prevalence of the following CCI diagnostic groupings: Congestive heart failure, peripheral vascular disease, dementia, chronic pulmonary disease, connective tissue disease-rheumatic disease, diabetes with and without complications, and moderate or severe liver disease. These diagnostic categories were examined since their presence may lead some anesthesiologists to avoid nerve block placement. The association between diagnostic categories and primary payment methodology groupings was examined via stratified univariate analysis. Finally, we conducted a separate stratified logistic regression model testing the odds of receiving a nerve block as a function of the above listed CCI diagnostic categories.

Statistical Analysis

In all analyses, we applied discharge weights provided in the NSAS to generate national estimates. Univariate analyses were reported for gender, age, primary method of payment, anesthesia provider, type of orthopedic surgery, type of healthcare facility, discharge information, case complexity, length and cost of surgery, and side effect profiles. The logistic regression modeled the probability of nerve block placement as a function of primary payment method, surgical group (based upon CPT code as defined in the Appendix), type of anesthesia provider (anesthesiologist vs. anesthesiologist supervising a CRNA), gender, age, type of facility (freestanding versus hospital-based), service area (metropolitan versus rural), number of diagnoses, number of procedures performed, and duration of surgery. This was conducted using the PROC SURVEYLOGISTIC function in SAS. The dataset employed multi-stage design variables to protect the confidentiality of the responding facilities; hence, we incorporated the relevant NSAS variables, STRATA and WEIGHT, for stratification and weighting using first-order Taylor series approximation of the deviation of estimates to adjust for the multistage sampling.[9,10] Odds ratios for covariates obtained from the logistic regression were reported, as was the C-statistic, equivalent to the area under the receiver operating curve, for the model itself. Lastly, likelihood of primary payment methodology on nerve block utilization was stratified across gender, service area, type of facility, type of anesthetic provider, and type of surgery. Statistical significance for all tests was predetermined at 0.05. Statistical analysis was performed using SAS 9.2 (SAS, Cary, NC).

CHAPTER 3
RESULTS

The complete NSAS dataset 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 over 3.9 million orthopedic anesthetics (Appendix). Table 3-1 describes the univariate distributions between those patients receiving nerve blocks and those anesthetized without a nerve block for orthopedic surgery. Overall, 14.9% of anesthetics in this sample involved a peripheral nerve block. The use of nerve blocks was commonly combined with monitored anesthesia care, intravenous sedation, and general anesthesia, but rarely with neuraxial anesthetics (Table 3-2).

In the univariate analysis, no statistically significant difference was observed for gender, discharge disposition, emergency department (ED) visits, or hospital admissions via the ED between 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 payment method (Table 3-1).

The vast majority of patients had a CCI score of zero regardless of use of nerve block. This finding was somewhat similar for type of payment, with 93% of government-sponsored, 97% of private, and 90% of charity care groups with a CCI score of zero. 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). Notably, there were differences in the proportion of patients with uncomplicated diabetes according to primary payment methodology (3% for government-sponsored, 1.4% for private and 0.4% for charity care, p=0.0002) (Tables 3-3 and 3-4).

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 (74.5 minutes, 95% CI 69.7-79.4, versus 85 minutes, 95% CI 81.3-88.8, p<0.0001), as was the total perioperative time. Total surgical charges were less for those patients receiving a nerve block ($6,359.70, 95% CI 5,638.63-7,080.77 versus 8151.50, 95% CI 7,418.45-8,884.55, p<0.0001) (Table 3-5).

In multivariate regression model, primary payment method significantly affected the likelihood of receiving a nerve block in this sample (p<0.001, C-statistic 0.702) (Table 3-6). When compared with self-pay or charity care, government supported sources of payment were 2.5 times (95% CI, 1.01-6.21, p=0.048) more likely to receive a nerve block. Similarly, patients reporting private insurance were 2.6 times (95% CI, 1.12-6.13, p=0.027) 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, p=0.0007), repair of muscles or fascia (OR 3.9, 95% CI 2.34-6.49, p<0.0001), and upper extremity joint repair (OR 4.6, 95% CI 2.78-7.61, p<0.0001) increased the odds of a peripheral nerve block compared with other types of surgery. Metropolitan service area increased the likelihood of a nerve block (OR 1.86, 95% CI 1.19-2.91, p=0.007) compared with non-metropolitan areas, as did freestanding (OR 2.27, 95% CI 1.74-2.96, $p<0.0001$) 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 (Table 3-6).

Last, we examined the relationship between insurance status and nerve block utilization across differing strata. Likelihood of nerve block placement for government-sponsored primary payment methodology (ESOP Group 1) versus self or charity-care (ESOP Group 3) was increased for male gender (OR 3.8, 95% CI 1.2-12), freestanding type of surgical facility (OR 5, 95% CI 1.7-15.3), metropolitan service area (OR 3.1, 95% CI 1.1-8.9), anesthesiologist-only provider status (OR 13.5, 95% CI 4.9-36.9), and upper extremity joint repair surgery (OR 10.3, 95% CI 1.6-65.1) (Figure 3-1). In comparing privately-insured primary payment methodologies (ESOP Group 2) with self or charity care (ESOP Group 3), male gender (OR 5.3, 95% CI 1.9-14.9), freestanding type of surgical facility (OR 4.5, 95% CI 1.7-12.5), metropolitan service area (OR 3.4, 95% CI 1.3-9.1), anesthesiologist-only provider status (OR 9.6, 95% CI 3.7-25.1), incision, excision or division of bones (OR 9.3, 95% CI 1.2-74.2) and upper extremity joint repair (OR 8.3, 95% CI 1.4-48.2) were associated with increased likelihood of nerve block placement (Figure 3-2).

Table 3-1. Univariate analysis of patient, surgical and anesthetic factors associated with nerve block placement

Variables	No nerve block	Nerve block	P-value
N	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, %)			<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, %)*			<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)	
Metropolitan status (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)	
Followup (weighted no, %)			
Patient reported problem on followup	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

*Type of orthopedic surgery classified according to ICD-9 procedure codes. Detailed description can be viewed in the Appendix.

Table 3-2. Use of additional anesthetics in presence of 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

Table 3-3. Associations between comorbidities and type 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

Table 3-4. Association between comorbidities and use of nerve block for ambulatory surgery

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

Table 3-5. 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 3-6. Factors associated with the likelihood of nerve block placement.

Variables	Odds ratio (95% Wald CI)	P-value
Demographic		
Age (per year)	1.01 (1.00-1.02)	0.07
Gender (female vs. male)	0.82 (0.63-1.06)	0.13
Anesthesia provider		
Anesthesiologist only (vs. 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 (vs. other)	4.6 (2.78-7.61)	<.0001
Lower extremity joint repair (vs. other)	1.51 (0.86-2.67)	0.15
Primary payment method		
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

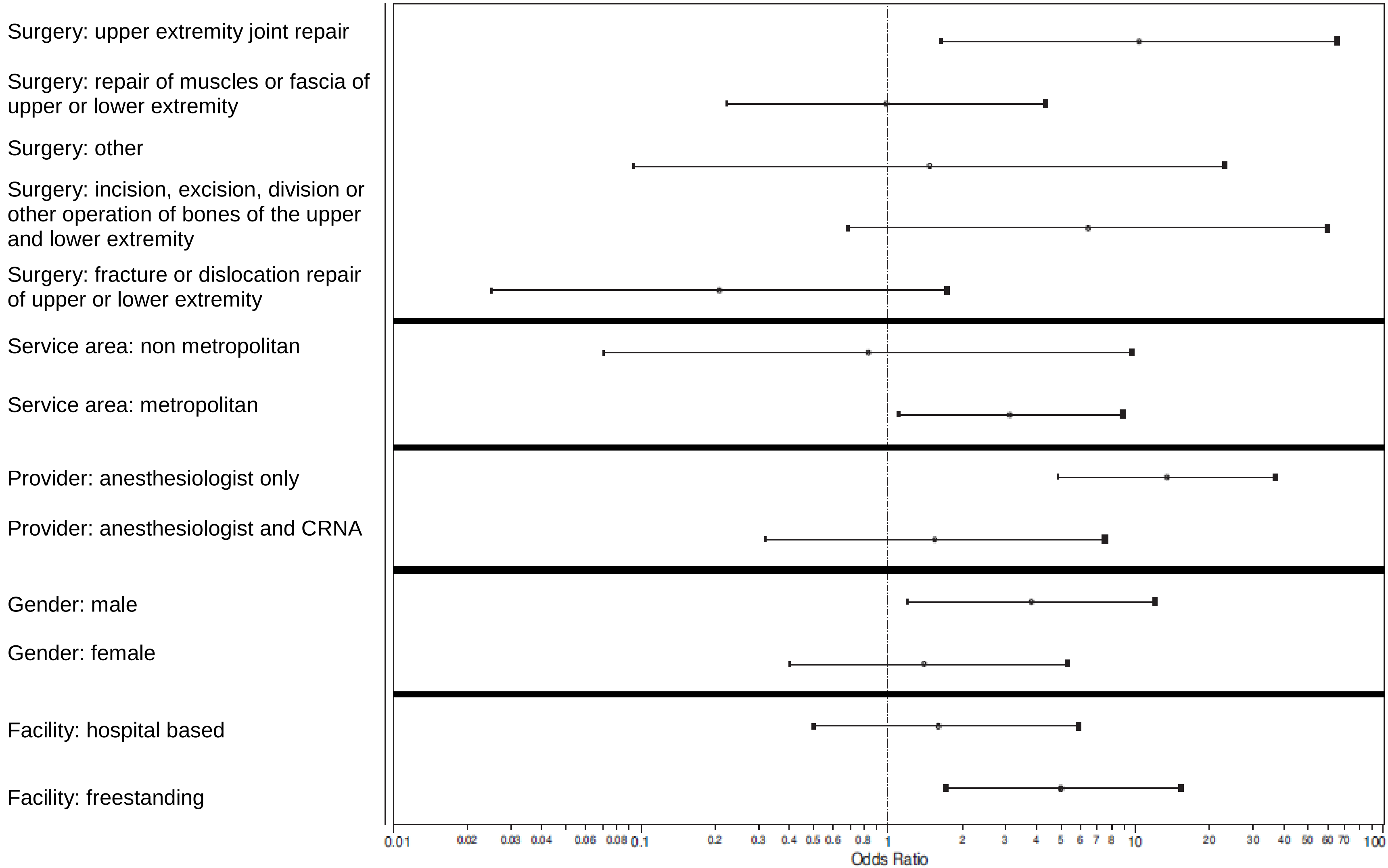

Figure 2-1. Subgroup comparison of odds ratio estimates for nerve block utilization in government-sponsored primary payment group versus self-pay and charity care payment group.

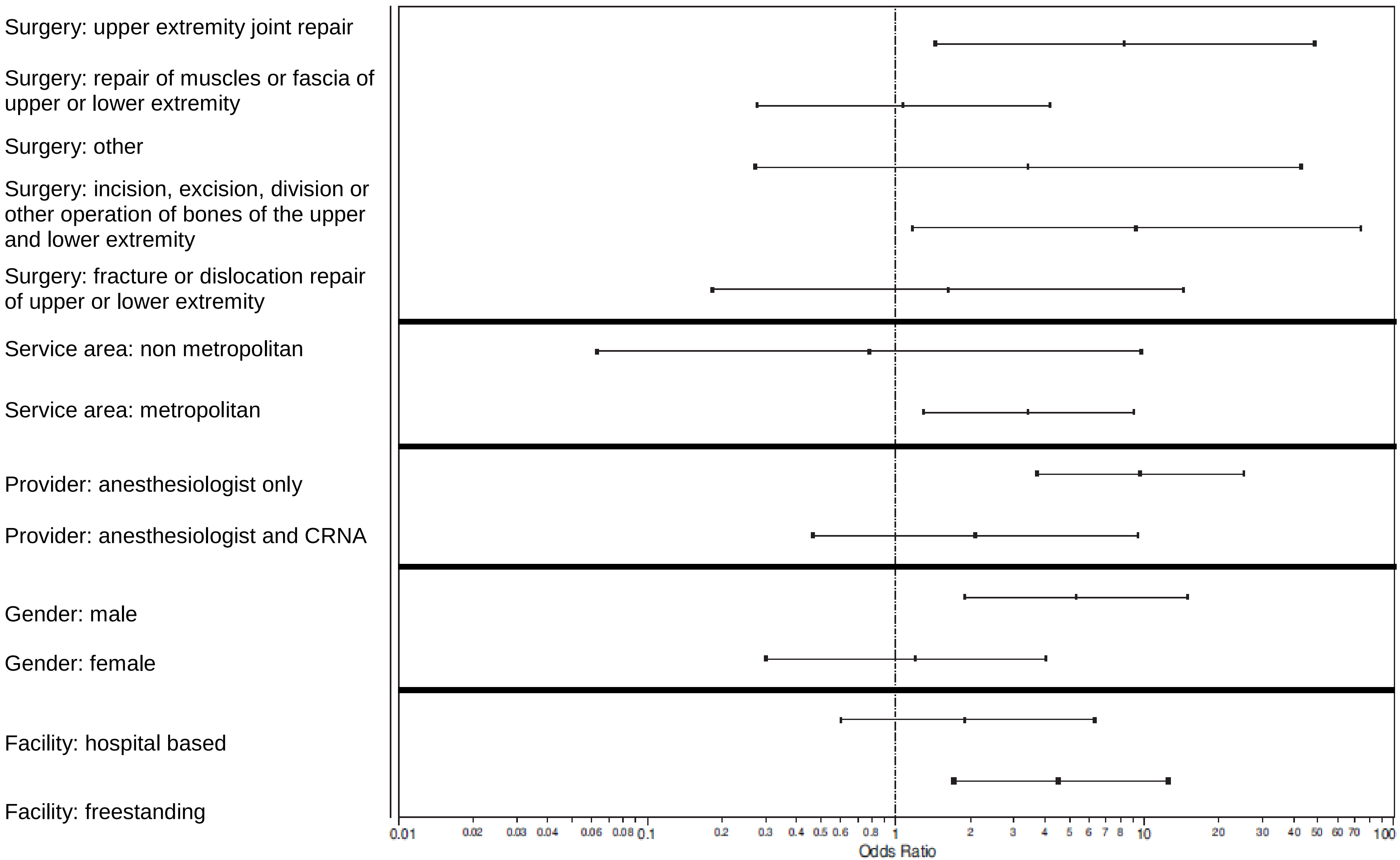

Figure 2-2. Subgroup comparison of odds ratio estimates for nerve block utilization in privately-insured primary payment group versus self-pay and charity care payment group.

CHAPTER 4
DISCUSSION

For patients undergoing orthopedic ambulatory surgery, the likelihood of receiving a nerve block was significantly affected by the primary payment method. 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 dataset exhibited a low rate of comorbid conditions according to the Charlson Comorbidity Index. This low rate was observed across both types of payment as well as utilization 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 over nerve injury.[11-13] Such comorbid conditions may also be associated with lower socioeconomic status.[14-16] Our data actually demonstrated a higher rate of diabetes for those patients with government-sponsored primary payment, although the presence of diabetes was not associated with the use or avoidance of a nerve block.

Most striking was the effect of the primary payment method on the likelihood of nerve block placement. 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 over 43 million uninsured Americans in 2006, this represents a substantial difference in anesthetic care based upon socioeconomic and geographic factors.[2] 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.[17-20] Interpretation of these results would be greatly enhanced by inclusion of data concerning level of education, as the above results may be significantly confounded by this effect. Regardless of the true benefits and detractors 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.

The lack of a difference in provision of nerve blocks between genders and across different age groups is notable, considering the noted differences in pain characterization and response across age and gender.[21-23] Regardless, patients receiving nerve blocks had similar surgical times, and yet still had a slightly lower recovery room time by univariate analysis, suggesting improvements in the recovery profile. The reduction in recovery time is similar to prior findings suggesting shortened hospital stays in patients receiving peripheral nerve blocks.[24] Use of a nerve block was associated with lower total perioperative charges. Although this may be attributable to time savings from the nerve block, the coarse surgical grouping employed in this analysis renders such conclusions suspect at best, as the cost differences may in actuality be correlated with differences in surgical procedure. This finding is nevertheless notable in light of the differences in nerve block utilization 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.[24-26] Our results suggest that patients receiving nerve blocks had very similar surgical and total OR times, but does not differentiate where nerve blocks were placed. The lack of a significant difference between surgical and total OR times suggests nerve blocks are being routinely placed in a preoperative setting, or expeditiously within the OR. Regardless, the data suggests that nerve blocks used for anesthesia in orthopedic surgical procedures do not routinely lead to more time within 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 some observations to carry exaggerated or minimized influence during construction of statistical models. Thus, inclusion of weighting and stratification variables into 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 for specific surgical procedures.

With over three 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.

APPENDIX
Surgical ICD9 Procedure Codes by Group

Incision or Excision of Bones, Upper or Lower Extremity

Incision, Excision, division or other operation of bones of the Upper Extremity

7701 7713 7714 7731 7733 7734 7751 7752 7753 7754 7761 7763 7764 7781 7782 7783 7784 7794 7801 7802 7803 7804 7811 7812 7813 7814 7821 7822 7823 7824 7831 7832 7833 7834
7841 7842 7843 7844 7851 7852 7853 7854 7861 7862 7863 7864 7871 7872 7873 7874

Incision, Excision, division or other operation of bones of the Lower Extremity
7718 7719 7728 7729 7737 7738 7745 7747 7748 7756 7757 7758 7765 7766 7767 7768 7787 7788 7797 7798 7805 7806 7807 7808 7815 7816 7817 7818 7825 7826 7827 7828 7835 7836 7837 7838 7845 7846 7847 7848 7855 7856 7857 7858 7865 7866 7867 7868 7875 7876 7877 7878

Fracture or Dislocation Repair, Upper or Lower Extremity

Repair of fracture or dislocation of the upper extremity

7901 7902 7903 7904 7911 7912 7913 7914 7921 7922 7923 7924 7931 7932 7933 7934 7941 7942 7943 7944 7951 7952 7953 7954 7961 7962 7963 7964 7971 7972 7973 7974 7981 7982 7983 7984

Repair of fracture or dislocation of the lower extremity

7905 7906 7907 7908 7915 7916 7917 7918 7925 7926 7927 7928 7935 7936 7937 7938 7945 7946 7947 7948 7955 7956 7957 7958 7965 7966 7967 7968 7975 7976 7977 7978 7985 7986 7987 7988

Repair of Muscles or Fascia, Upper or Lower Extremity

Operations on the muscle, tendon and fascia of the hand

8201 8202 8203 8204 8209 8211 8212 8219 8221 8222 8229 8231 8232 8233 8234 8235 8236 8239 8241 8242 8243 8244 8245 8246 8251 8252 8253 8254 8255 8256 8257 8258 8259 8261 8269 8271 8272 8279 8281 8282 8283 8284 8285 8286 8289 8291 8292 8293 8294 8295 8296 8299

Operations on the muscle, tendon, fascia and bursa outside of the hand

8301 8303 8302 8309 8313 8314 8319 8321 8329 8331 8332 8339 8341 8342 8343 8344 8345 8349 835- 8361 8362 8364 8365 8371 8372 8373 8374 8375 8376 8377 8379 8381 8382 8383 8385 8387 8388 8389 8391 8392 8393 8394 8395 8396 8397 8398 8399

Upper Extremity Joint

Excision or incision to shoulder

8001 8011 8021 8031 8041 8071 8081 8091 8363

Excision or incision to elbow

8002 8012 8022 8032 8042 8072 8082 8092

Excision or incision to wrist, hand and finger

8003 8013 8023 8033 8043 8073 8083 8093 8004 8014 8024 8034 8044 8074 8084 8094

Arthrodesis of Upper Extremity Joint

8123 8124 8125 8126 8127 8128

Joint replacement or revision of joint replacement of the upper extremity

8180 8181 8182 8183 8184 8185 8171 8172 8173 8174 8175 8179 8193 8197

Amputation of Upper Extremities

8400 8401 8402 8403 8404 8405 8406 8407 8408 8409

Lower Extremity Joint Repair

Excision or incision to hip

8005 8015 8025 8035 8045 8075 8085 8095 8140 8312

Excision or incision to knee

8006 8016 8026 8036 8046 806- 8076 8086 8096 8142 8143 8144 8145 8146 8147 8386

Excision or incision to ankle, foot or toe

8007 8017 8027 8037 8047 8077 8087 8097 8008 8018 8028 8038 8048 8078 8088 8098 8149 8311 8384

Arthrodesis of lower extremity joint

8111 8112 8113 8114 8115 8116 8117 8118 8121 8122

Joint replacement or revision of joint replacement of the lower extremity

8151 8152 8153 8154 8155 8156 8157 8159 8194 8195

Amputation of lower extremities

8410 8411 8412 8413 8414 8415 8416 8417 8418 8419

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BIOGRAPHICAL SKETCH

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