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Patient-, Treatment-, and Facility-Level Structural Characteristics Associated With the Receipt of Preoperative Lower Extremity Amputation Rehabilitation

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Abstract

Objectives—To determine patient, treatment, or facility characteristics that influence decisions to initiate a rehabilitation assessment before transtibial or transfemoral amputation within the Veterans Affairs (VA) health care system.

Design—Retrospective database study.

Setting—VA medical centers.

Participants—A total of 4226 veterans with lower extremity amputations discharged from a VA medical center between October 1, 2002, and September 30, 2004.

Outcome—Evidence of a preoperative rehabilitation assessment after the index surgical stay admission but before the surgical date.

Results—Evidence was found that 343 of 4226 veterans (8.12%) with lower extremity amputations received preoperative rehabilitation assessments. Veterans receiving preoperative

rehabilitation were more likely to be older, admitted from home, or transferred from another hospital. Patients who underwent surgical amputation at smaller-sized hospitals or in the South Central or Mountain Pacific regions were more likely to receive preoperative rehabilitation compared with patients in mid-sized hospitals or in the Northeast, Southeast, or Midwest regions. Patients with evidence of paralysis, patients treated in facilities with programs accredited by the Commission on Accreditation of Rehabilitation Facilities ($P < .01$), and patients in the second data wave were less likely to receive preoperative rehabilitation. After accounting for patient-, treatment-, and facility-level structural characteristics, we found that older patients were more likely to receive preoperative rehabilitation services (odds ratio [OR] 1.01, 95% confidence interval [CI] 1.01–1.02). Patients with a contributing amputation etiology of a previous amputation complication were more likely to receive preoperative consultation rehabilitation services (OR 1.50, 95% CI 1.02–2.19) compared with patients who did not have this etiology. Compared with patients treated in the Southeast region of the United States, those treated in the South Central region (OR 2.52, 95% CI 1.82–3.48) or Mountain Pacific region (OR 1.62, 95% CI 1.11–2.37) were more likely to receive preoperative consultation rehabilitation services. Patients with evidence of paralysis were less likely to receive preoperative rehabilitative services compared with patients who did not have this condition (OR 0.29, 95% CI 0.09–0.93), and patients treated in mid-sized hospitals also were less likely to receive preoperative rehabilitative services compared with patients treated in smaller-sized facilities (OR 0.38, 95% CI 0.27–0.53). Veterans in the second data year were less likely to receive services compared with patients in the first year (OR 0.74, 95% CI 0.58–0.94).

Conclusions—Rehabilitation assessment before lower extremity amputation surgery is a rare occurrence in the VA health care system. Practice patterns appear to be driven by location and not by patient characteristics.

INTRODUCTION

Amputation of the lower extremity can result in significant impairment and disability, particularly for older patients. Primarily as the result of an aging population and high rates of dysvascular conditions in older adults, the number of lower extremity amputations performed in the United States is expected to increase to approximately 58,000 per year by 2030 [1]. The number of persons living with an amputation is expected to more than double by 2050 [2]. Consistent with this trend, in 2011, Tseng et al [3] found a marked reduction in the rate of lower extremity amputations in Department of Veterans Affairs (VA) hospitals between 2000 and 2004, while at the same time noting a 24% increase in the absolute numbers of major amputations. Defining optimal rehabilitation evaluation processes and care management for this population is critical to ensure that the best possible outcomes are achieved in a cost-effective manner.

The recently developed VA Guidelines for Rehabilitation of Lower Limb Amputation [4] recommend that key rehabilitation disciplines be consulted preoperatively, when the circumstance applies, for patients identified as needing an amputation. According to the guidelines, the goal of initiating rehabilitation before surgery is to “maximize the patient’s physical function before surgery and to prevent secondary complications.” This recommendation, which is based on expert consensus alone and is not supported in the document by published evidence, stressed the importance of a preoperative assessment by a multidisciplinary team that includes a rehabilitation specialist because of the belief that guiding surgical planning and patient education could ensure an optimal outcome despite future ambulatory potential. Hakimi [5] offered similar recommendations in a 2009 summary article.

The complex functional needs of patients with lower extremity amputation have not been well studied. Some evidence indicates that a patient’s preoperative level of functioning,

including ambulation, can be used to predict postoperative function [6,7], but it is unclear whether the initiation of rehabilitation before amputation is an optimal approach. This study is an effort to determine whether any particular patient-, treatment-, or facility-level characteristics are associated with the decision of health care providers within the VA health care system to initiate a rehabilitation assessment before a new transtibial or transfemoral amputation is performed. The Veterans Health Administration is the largest integrated health care system in the United States, and this type of study is possible only in the VA health care system because of its national data warehouse, which contains information from multiple sources, including a rehabilitation database (the Functional Status Outcomes Database [FSOD]).

METHODS

This study was approved by the institutional review board at each of the participating institutions.

Description of Databases

Data were obtained from 7 Veterans Health Administration administrative databases used to track the health status and health care use of veterans. The databases included 4 inpatient datasets referred to as the Patient Treatment Files (PTFs; main, procedure, bed section, and surgery) [8], 2 outpatient care files (visit and event) [9], and the FSOD [10]. The databases and our methods of data extraction have been described previously [11–14].

Study Population

The study included Veterans Affairs Medical Center (VAMC) patients who had hospital discharge dates between October 1, 2002, and September 30, 2004, for a new transtibial or transfemoral amputation identified through the following surgical *International Classification of Diseases*, 9th Revision, Clinical Modification (ICD-9-CM) procedure codes: 84.10, 84.13–84.19, and 84.91 [15]. Cases were excluded if the amputation involved toes only or if the patient had a record of a previous lower extremity amputation within the 12 months preceding the hospitalization of interest, because our objective was to study only new amputations within our time period. We combined records from the PTF bed section files with admission dates within 1 day of the patient's main hospitalization discharge date to capture the entire acute amputation hospitalization stay. The hospitalization (admission to discharge) at the time of the new amputation represented the "index surgical stay."

We identified 4727 veterans with lower extremity amputation who met these criteria. The first analysis was performed to determine the prevalence of receipt of any type of preoperative rehabilitation. We found 501 patients who had evidence of a V57 code in the PTF main dataset, indicating receipt of inpatient rehabilitation. However, this code does not have a date or type of rehabilitation indication, and thus it is unknown when inpatient rehabilitation was provided. These cases were excluded if no corresponding FSOD record was found. Thus to determine the prevalence of receipt of rehabilitation services, 4226 veterans (89.4%) were included.

The next analysis was conducted to find the factors associated with the clinical decision-making process for patients receiving preoperative consultation rehabilitation services. One patient was excluded because his living location before hospitalization was missing, and the 501 patients who had a V57 code indicating inpatient rehabilitation but no known date of service, type of rehabilitation, or FSOD record also were excluded. Because our intention was to study factors that appear to be associated with the decision to initiate a preoperative rehabilitation assessment, we excluded veterans who already were receiving rehabilitation

for other reasons. Specifically, we excluded 40 patients who had been in the spinal cord injury bed section before surgery because this bed section is associated with rehabilitation, 1 patient who was treated in a high-intensity rehabilitation bed section before surgery, and 1 patient with evidence of an FSOD record indicating specialized rehabilitation. These patients were excluded because we believed no additional preoperative decisions regarding their rehabilitation needs would be required. Therefore 4183 cases (88.5%) were included in the clinical decision-making analyses.

Patient-, Treatment-, and Facility-Level Structural Characteristic Definitions

Patient-level characteristics included age, gender, marital status (married or not married), and living location before hospitalization (hospital, home, or extended care). Diagnoses incorporated both contributing amputation etiologies and comorbidities. Etiologies and comorbidities were identified with use of ICD-9-CM diagnosis codes from outpatient care files 3 months before the hospital admission and from the main and bed section PTF files up to the surgical date. Ten of the original 12 etiologic categories were incorporated in our analyses, including chronic osteomyelitis, device infection, diabetes mellitus type I, diabetes mellitus type II, local significant infection, peripheral vascular disease, previous amputation complication, skin breakdown, systemic sepsis, and trauma [11]. Congenital deformity and lower-limb cancer were not sufficiently prevalent to be included in the analyses. In this study we used the 2003 version of the Elixhauser comorbidity measure, which includes 31 conditions and distinguishes hypertension with and without complications [16,17]. Because no cases included the ICD-9-CM code for obesity, obesity was not included. Diabetes mellitus and peripheral vascular disease were not included as comorbidities because they were categorized as amputation etiologies.

Treatment-level variables, which incorporated diagnostic tests and treatments including active pulmonary pathology, acute central nervous system pathology, mental status issues or substance abuse, ongoing active cardiac pathology, ongoing wound problems, serious nutritional compromise, or severe renal disease during the surgical hospitalization, were included if they occurred before surgery [13]. Other variables that approximated patient complexity included the number of bed sections in which the patient was treated before the surgical procedure and the average number of days from hospital admission to surgery.

In an effort to explore whether referral patterns to preoperative consultation rehabilitation differed according to specialty type, we determined the type of bed section where the patient was treated at the time of surgery. The original 31 bed sections within the PTF bed section file from our data were reclassified by the clinician authors. The intent was to form a smaller number of groups with a sufficient sample that could be analyzed by combining similar service types. The new bed section classification included *surgical specialties* (general surgery, neurosurgery, orthopedic, plastic surgery, thoracic surgery, surgical observation, urology, ear, nose, and throat, ophthalmology, and podiatry), *surgical intensive care unit*, *medical* (cardiology, hematology, neurology, general acute medicine, proctology, allergy, hematology-oncology, metabolic, medical observation, pulmonary nontuberculosis, and geriatric evaluation and management acute medicine), *medical intensive care* (medical intensive care unit, telemetry, and cardiac step down), *high intensity rehabilitation/spinal cord injury* (rehabilitation medicine, blind rehabilitation, sustained treatment and rehabilitation, and spinal cord injury), *extended care* (intermediate medicine, nursing home care, gerontology, geriatric evaluation and management nursing home care, geriatric evaluation and management rehabilitation, and geriatric evaluation and management intermediate care), *peripheral vascular*, or *psychiatric* (psychiatry general intervention, high-intensity general psychiatry, and inpatient and geriatric evaluation and management psychiatry). No patients were treated in a psychiatric bed section at the time of surgery, and thus this bed section was not included in the analyses.

Facility-level structural characteristics included geographic region (Veterans Integrated Service Networks mapped into Centers for Medicare and Medicaid Service regions: Northeast, Southeast, Midwest, South Central, or Pacific Mountain), hospital bed size (126, 127–244, 245–362, or >362), and Commission on Accreditation of Rehabilitation Facilities accreditation of the facility in which the surgery occurred. A year variable was added to account for any practice pattern changes during the 2-year period.

Outcome Measure

The outcome of this study was evidence of preoperative consultation rehabilitation after the index surgical stay admission but before the surgical date, based on a consultation admission record in the FSOD.

Statistical Analyses

Baseline patient-, treatment-, and facility-level structural characteristics were compared among patients who did and did not have evidence of preoperative rehabilitation services. These comparisons were conducted through χ^2 analyses or Student *t*-tests. *P* values were 2-sided, with statistical significance at *P* < .05.

A generalized estimating equation model was used to model the outcome of evidence of preoperative consultation rehabilitation, which properly accounts for correlations among outcomes of patients from the same VAMC because patients are clustered into facilities [18]. The outcome is an indicator of evidence of preoperative consultative rehabilitation. All known patient-, treatment-, and facility-level structural characteristics in the generalized estimating equation model described previously were considered. Each variable entered the unadjusted model one at a time. Variables significant at *P* < .05 were added to a multivariate model. Clinically important variables, such as age, marital status, and living location before hospitalization, were forced into the initial multivariable model if they were not significant in the unadjusted individual models. We then used backward selection to obtain the final model until all variables kept were significant. Odds ratios (ORs) and 95% confidence intervals (CIs) were obtained from the variables that remained in this final model to determine the patient-, treatment-, and facility-level structural predictors of preoperative consultation rehabilitation services. All statistical analyses were performed with SAS version 9.2 [19].

RESULTS

After excluding the 501 patients with V57 codes that do not provide information about the date of rehabilitation services, we found that the prevalence of receiving some type of preoperative rehabilitation service was 8.12% (343 of 4226 veterans).

Table 1 compares baseline characteristics of patients who did and did not receive preoperative rehabilitation consultation services on the basis of the 4183-patient sample that was used in the clinical decision-making analysis. Patients who received preoperative consultative services were more likely to be older (68.31 versus 67.02 years, *P* = .03). Veterans who received preoperative rehabilitation services were more likely admitted to the hospital from home (90.33%) than were veterans who did not receive preoperative rehabilitation services (84.63%). Conversely, veterans who did not receive preoperative rehabilitation services were more likely to be admitted from an extended care facility (12.39%) compared with veterans who received services (6.67%, *P* = .01). Patients were more likely to receive preoperative consultation rehabilitation services if they had their surgical amputation in the South Central (34.33% versus 20.45%) or Mountain Pacific (17.33% versus 14.06%) regions of the country and less likely to receive a preoperative

assessment if they had surgery in the Northeast (11.33% versus 15.14%), Southeast (23.33% versus 30.44%) or Midwest (13.67% versus 19.91%) ($P < .0001$). Patients were more likely to receive preoperative consultation rehabilitation treatment if they were treated in hospitals of a smaller size, that is, with fewer beds ($P < .0001$).

Patients were less likely to receive preoperative consultation rehabilitation services compared with patients receiving those services if they had evidence of paralysis (3.76% versus 1.00%, $P = .01$), if they were treated in Commission on Accreditation of Rehabilitation Facilities–accredited facilities (45.87% versus 35.33%, $P < .01$), or if they were in the second wave of data (49.81% versus 42.33%, $P = .01$).

Table 2 shows the adjusted results after backward selection. After accounting for patient-, treatment-, and facility-level structural characteristics, we found that patients with increased age were more likely to receive preoperative consultation rehabilitation services (OR 1.01, 95% CI 1.01–1.02). Patients with a contributing amputation etiology of previous amputation complication were more likely to receive preoperative consultation rehabilitation services (OR 1.50, 95% CI 1.02–2.19) compared with patients without this etiology. Compared with patients treated in the Southeast region of the United States, those treated in the South Central region (OR 2.52, 95% CI 1.82–3.48) or Mountain Pacific region (OR 1.62, 95% CI 1.11–2.37) were more likely to receive preoperative consultation rehabilitation services.

Patients with evidence of paralysis were less likely to receive preoperative consultation rehabilitative services compared with patients who did not have this condition (OR 0.29, 95% CI 0.09–0.93). Veterans treated in mid-sized hospitals (ie, a bed size of 245–362) were less likely to receive preoperative consultation rehabilitation services compared with patients treated in smaller-sized facilities (OR 0.38, 95% CI 0.27–0.53). Patients in the second year of data were less likely to receive services compared with patients in the first year of data (OR 0.74, 95% CI 0.58–0.94).

DISCUSSION

Despite apparent consensus among rehabilitation professionals [4,5], a rehabilitation assessment that includes a standardized functional assessment before lower extremity amputation surgery appears to be a rare event within the VA health care system. In contrast, nearly 75% of veterans receive postoperative rehabilitation after an amputation [12,20]. This finding was somewhat unexpected but suggests that although rehabilitation continues to be a priority after surgery in the management of patients with amputations in the VA health care system, it is not a primary consideration preoperatively. Only 8% of veterans who underwent a lower extremity amputation during the time frame studied had evidence of a preoperative assessment by a rehabilitation professional in the first data wave, and this figure decreased to 6.5% in the second data wave.

Although certain patient-level characteristics were associated with being more or less likely to receive a preoperative rehabilitation assessment, these characteristics do not appear to be the primary determinants driving the decisions to provide this service. Older patients were more likely to receive a preoperative rehabilitation assessment than were younger patients. It may be that because older patients tend to have more comorbidities, clinical care teams chose to pull in additional consultants to assist with their management in the preoperative phase. Evidence of a previous amputation complication also was associated with a greater likelihood of having a rehabilitation assessment before surgery. Patients with complications related to an earlier amputation may be known to the rehabilitation team, and this familiarity may positively influence the treating team's decision to request rehabilitation input.

Paralysis, the only comorbid condition found to be significant, was negatively associated with receipt of preoperative rehabilitation. Although it is difficult to attribute clinical significance to this finding with certainty, it may be that the presence of paralysis was viewed as a barrier to rehabilitation among those with limb loss. We found previously that a prosthetic limb was less likely to be prescribed for patients with paralysis compared with nonparalyzed patients [13].

The location of veterans before their admission for surgery was a factor in whether a preoperative rehabilitation assessment was completed. Veterans were more likely to receive preoperative rehabilitation if they were admitted from home, whereas patients were less likely to receive preoperative rehabilitation services if they were in an extended-care setting before their surgeries. However, these findings were not statistically significant in the final adjusted model. Patients coming from an extended-care setting may have been considered “poor” rehabilitation candidates by the admitting care team and not in need of a preoperative assessment. Alternatively, patients admitted from home could have been more stable, allowing adequate time between the decision to operate and the actual procedure for a rehabilitation assessment to take place. Input from the rehabilitation team could be considered helpful to the admitting team and thus desirable for the patient.

The size and type of facility had a significant impact on whether patients received a preoperative rehabilitation assessment. In this study, patients who underwent an amputation at a smaller facility were actually more likely to undergo a preoperative assessment than were those who had surgery in a larger facility. Again, this finding is somewhat unexpected; however, it may be that small facilities have well-defined processes in place to systematically identify patients admitted for amputation surgery and thus routinely provide preoperative rehabilitation consultations. It also may be that in the lower-volume facilities, it is easier for rehabilitation programs to track patients and therefore staff members are more aware of the needs of patients being admitted to the facility.

Patients were more likely to receive preoperative rehabilitation if they were located in the South Central and the Pacific Mountain regions of the United States, suggesting again that care pattern decisions are associated with the characteristics of the facility and are not strictly attached to guidelines in rehabilitation care. This finding was not unexpected. In previous studies regarding rehabilitation in patients who had a stroke or a lower extremity amputation, it was found that both patient complexity and structural elements influence the type of rehabilitation received [12,21]. Detailed knowledge of the types of rehabilitation programs offered within each region was not available. Differences in availability of preoperative rehabilitation might be explained in part by variation in resources between regions.

The potential benefit to the patient of having rehabilitation professionals involved in their care before amputation surgery is significant. A thorough functional and cognitive assessment can help surgeons understand possible long-term goals and outcomes and help determine optimal levels of amputation. Using retrospective data, Taylor et al [6] found that several patient characteristics, including functional and ambulation status, were associated with postoperative outcomes, including use of a prosthesis. Although a formal preoperative assessment was not part of their standardized surgical and rehabilitation program after transtibial amputation, Johannesson et al [22] recommended that a preoperative assessment include walking ability to better determine rehabilitation potential. Pinzur et al [7] also found that preoperative ambulation status was associated with postoperative function. A detailed functional history of ambulation, activities of daily living, and community activities is critical to the development of an appropriate rehabilitation plan, and often this history can give insight to the care team and the patient and family regarding the potential for prosthetic

limb use after the surgery. Patients who have a marginal level of functioning preoperatively or who have limited cognitive capacity may not be candidates for a prosthetic limb but could have other rehabilitation goals, including caregiver education. Identifying these patients preoperatively and providing counseling and education with appropriate goals in mind may result in better quality of life.

For patients who may be candidates for a prosthetic postoperatively, early identification and initiation of rehabilitation in the preoperative setting could streamline patient flow, reduce inpatient length of stay, and potentially result in better long-term outcomes. For patients who will not use prosthetics, early rehabilitation goals including wheelchair mobility and the maintenance of self-care function still could be established and potentially met, thus enhancing the patient's quality of life and autonomy. Preparing patients preoperatively for their long-term mobility goals and other adaptations to limb loss is important, and understanding their rehabilitation potential and goals after this life-altering surgery might offer hope to the patient at a stressful time. Providing families with realistic options also is important as they prepare to assist and support the patient.

This study has several limitations. Evidence of preoperative rehabilitation was obtained through the FSOD, which is dependent on clinician data entry, and patients may have received a preoperative rehabilitation assessment that was not identified in this database. Facilities within the VA health care system are not required to complete preoperative assessments; however, during 2002–2004, facilities were required to complete a postoperative assessment [23]. Some rehabilitation services may have initiated contact preoperatively but may not have completed their formal assessment, and thus they might have entered data into the FSOD only after surgery. In addition, the study was limited to care processes within the VA health care system, which has predominantly a male population. Although these findings of limited preoperative rehabilitation input within the VA health care system cannot necessarily be generalized to the larger U.S. population, the degree to which patients in the larger U.S. population receive preoperative rehabilitation could not easily be addressed because no national-level formalized indicators of preoperative rehabilitative assessment exist in private-sector services.

CONCLUSIONS

Rehabilitation assessment before lower extremity amputation surgery is a rare occurrence in the VA health care system despite recent practice guidelines suggesting expert consensus of the need. Practice patterns appear to be driven primarily by location and not by patient-level characteristics. Future research is needed to understand the potential benefit of preoperative rehabilitation input.

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Table 1

Unadjusted comparisons between patients who do and do not receive preoperative rehabilitation services

	Received Preoperative Rehabilitation (n = 300)	Did Not Receive Preoperative Rehabilitation (n = 3883)	P Value
Demographic contents			
Average age, y (SD)	68.31 (10.00)	67.02 (11.32)	.03
Gender			
Male	297 (99.00)	3846 (99.05)	.94
Female	3 (1.00)	37 (0.95)	
Marital status			
Married	131 (43.67)	1748 (45.02)	.65
Not married	169 (56.33)	2135 (54.98)	
Living location before hospitalization			
Home	271 (90.33)	3286 (84.63)	.01
Hospital	9 (3.00)	116 (2.99)	
Extended care	20 (6.67)	481 (12.39)	
Elixhauser comorbidities			
Arrhythmias			
Yes	59 (19.67)	697 (17.95)	.46
No	241 (80.33)	3186 (82.05)	
Chronic pulmonary disease			
Yes	56 (18.67)	799 (20.58)	.43
No	244 (81.33)	3084 (79.42)	
Congestive heart failure			
Yes	72 (24.00)	947 (24.39)	.88
No	228 (76.00)	2936 (75.61)	
Depression			
Yes	26 (8.67)	366 (9.43)	.66
No	274 (91.33)	3517 (90.57)	
Fluid and electrolyte disorders			
Yes	56 (18.67)	881 (22.69)	.11
No	244 (81.33)	3002 (77.31)	
Other neurologic disorders			
Yes	5 (1.67)	120 (3.09)	.16
No	295 (98.33)	3763 (96.91)	
Paralysis			
Yes	3 (1.00)	146 (3.76)	.01
No	297 (99.00)	3737 (96.24)	
Rheumatoid arthritis			
Yes	2 (0.67)	57 (1.47)	.26
No	298 (99.33)	3826 (98.53)	
Valvular disease			
Yes	13 (4.33)	204 (5.25)	.49

	Received Preoperative Rehabilitation (n = 300)	Did Not Receive Preoperative Rehabilitation (n = 3883)	P Value
No	287 (95.67)	3679 (94.75)	
Treatment variables			
Bed section at the time of surgery			
Surgical	116 (38.67)	1267 (32.63)	.21
Surgical intensive care unit	59 (19.67)	862 (22.20)	
Medical	36 (12.00)	551 (14.19)	
Medical intensive care unit	11 (3.67)	224 (5.77)	
Extended care	3 (1.00)	34 (0.88)	
Peripheral vascular surgery	75 (25.00)	945 (24.34)	
No. of bed section before surgery (SD)	1.64 (1.04)	1.57 (1.04)	.26
Average days from admission to surgery (SD)	10.00 (11.72)	9.06 (28.21)	.25
Hospital characteristics			
Regions			
Northeast	34 (11.33)	588 (15.14)	<.0001
Southeast	70 (23.33)	1182 (30.44)	
Midwest	41 (13.67)	773 (19.91)	
South Central	103 (34.33)	794 (20.45)	
Mountain Pacific	52 (17.33)	546 (14.06)	
Total bed size			
126	107 (35.67)	1124 (28.95)	<.0001
127–244	123 (41.00)	1122 (28.90)	
245–362	55 (18.33)	1345 (34.64)	
>362	15 (5.00)	292 (7.52)	
CARF accreditation			
Yes	106 (35.33)	1781 (45.87)	<.01
No	194 (64.67)	2102 (54.13)	
Wave			
Year 1	173 (57.67)	1949 (50.19)	.01
Year 2	127 (42.33)	1934 (49.81)	

CARF = Commission on Accreditation of Rehabilitation Facilities.

Values in parentheses are percentages unless otherwise noted.

Table 2

Adjusted results

	Odds Ratio	95% Confidence Interval	P Value
Demographic contents			
Age	1.01	1.01–1.02	.04
Amputation etiology			
Previous amputation complication	1.50	1.02–2.19	.04
Elixhauser comorbidities			
Paralysis	0.29	0.09–0.93	.04
Hospital characteristics			
Regions (Reference: Southeast)			
Northeast	0.95	0.59–1.51	.82
Midwest	0.86	0.57–1.28	.45
South Central	2.52	1.82–3.48	<.0001
Mountain Pacific	1.62	1.11–2.37	.01
Total bed size (Reference: size 126)			
Bed size 127–244	1.13	0.86–1.50	.38
Bed size 245–362	0.38	0.27–0.53	<.0001
Bed size >362	0.76	0.40–1.42	.39
Wave (reference: year 1)			
Year 2	0.74	0.58–0.94	.01