ORIGINAL ARTICLE

Does the Presence of a Specialized Rehabilitation Unit in a Veterans Affairs Facility Impact Referral for Rehabilitative Care After a Lower-Extremity Amputation?

Barbara E. Bates, MD, Jibby E. Kurichi, MPH, Clifford R. Marshall, MS, Dean Reker, PhD, Greg Maislin, MS, MA, Margaret G. Stineman, MD

ABSTRACT. Bates BE, Kurichi JE, Marshall CR, Reker D, Maislin G, Stineman MG. Does the presence of a specialized rehabilitation unit in a Veterans Affairs facility impact referral for rehabilitative care after a lower-extremity amputation? Arch Phys Med Rehabil 2007;88:1249-55.

Objective: To determine if the presence of specialized rehabilitation units (SRUs) within Veterans Affairs medical centers (VAMC) influences access to rehabilitation services.

Design: Retrospective cohort analysis.

Setting: Two types of VAMCs: those with and without SRUs.

Participants: Veterans with lower-extremity amputations discharged from VAMCs between October 1, 2002, and September 30, 2003. There were a total of 2375 veterans with amputations: 99% were men; and 60% had transtibial, 40% had transfemoral, and less than 1% had hip disarticulation amputations. Nine hundred sixty-six patients (41%) were seen at a VAMC with an SRU.

Interventions: Not applicable.

Main Outcome Measure: Level of service provided expressed as: no evidence of rehabilitation during the hospitalization, generalized rehabilitation through consultation only, or admission to an SRU.

Results: There were no differences between patients treated at facilities with SRUs and those treated in a facility without SRU beds with respect to age, sex, marital status, source of hospital admission, or level of amputation (all $P<.05$). Patients with lower initial FIM instrument scores were more likely to be treated in facilities with SRUs, and to have longer lengths of acute hospitalization ($P<.01$). Patients at facilities with an SRU compared with those without an SRU had comparable likelihoods of being seen for an initial rehabilitation consultation (75% vs 74%, $P=.56$), but were more likely to be admitted for high intensity specialty rehabilitation services (26% vs 11%, $P<.01$).

Conclusions: Although the majority of patients were seen in consultation, structural differences in service availability among clinically similar populations appear to be causing access disparities to specialized rehabilitation among amputees in the VAMC setting. The implication of these differences with regard to patient outcomes will need to be determined.

Key Words: Amputation; Leg; Rehabilitation; Veterans.

AMPUTATION OF THE lower limb can result in permanent impairment and disability, reducing the capacity for productive activities among people of all ages, but especially in the elderly. Lower-limb amputations in the United States can be expected to double from 28,000 to 58,000 per year by 2030 because of the disproportionate shifts in the oldest segments of our population,[1] making cost-effective rehabilitation strategies to help elderly patients achieve independence and home discharge increasingly essential in the upcoming decades.

Rehabilitation immediately after the onset of any new impairment (including lower-extremity amputation) can be provided in a variety of ways that could be considered a continuum ranging from no rehabilitative intervention to high-intensity inpatient rehabilitation services on a specialized unit. Most hospitals have physical and occupational therapists that can be consulted postoperatively to help patients recover their functional abilities after limb loss. In addition to consultative services, some patients may be referred for admission to a specialized inpatient rehabilitation program, to a skilled nursing facility, or for home care or outpatient services only. Despite availability, consultation is not guaranteed, and patients can be discharged from acute care without ever being assessed for rehabilitation services.

There is evidence that, after a traumatic lower-extremity amputation, admission to a specialized inpatient rehabilitation program significantly improves functional and vocational outcomes and reduces bodily pain.[2] Although there is little evidence to date, it is logical to assume that similar benefits would be seen in patients who undergo amputations due to nontraumatic etiologies as well. As Dillingham et al[3,4] noted in 2 separate studies, few patients are referred to rehabilitation programs, however, with only 9.6% to 16% of patients discharged from acute services to inpatient rehabilitation after dysvascular amputation of a lower limb.

Admission into an inpatient rehabilitation program is dependent on numerous factors, including patient characteristics, referral practices, and the structures and processes within rehabilitation itself. This study is an attempt to determine if variation in structure and processes of care within the Veterans

From Physical Medicine Service, VAMC Albany, NY (Bates); Physical Medicine and Rehabilitation, Albany Medical College, Albany, NY (Bates); Department of Physical Medicine and Rehabilitation, University of Pennsylvania, Philadelphia, PA (Kurichi); Physical Medicine and Rehabilitation Program Office, Department of Veterans Affairs Central Office, Gainesville, FL (Marshall); VAMC Kansas City, Kansas City, MO (Reker); Kansas University Medical Center, Kansas City, MO (Reker); Division of Sleep Medicine/Department of Medicine, University of Pennsylvania School of Medicine, Philadelphia, PA (Maislin); and Department of Physical Medicine and Rehabilitation, University of Pennsylvania, VA Center for Health Equity Research and Promotion, Philadelphia, PA (Stineman).

Presented as a poster to the American Physical Medicine and Rehabilitation. September 2007, Boston, MA.

Supported in part by the National Institutes of Health (grant no. Ro1 HD042588), the Samuel S. Stratton Department of Veterans Affairs Medical Center, Albany, NY, and the Kansas City Department of Veterans Affairs Medical Center, Kansas City, MO.

No commercial party having a direct financial interest in the results of the research supporting this article has or will confer a benefit upon the author(s) or upon any organization with which the author(s) is/are associated.

Correspondence to Barbara E. Bates, MD, Quality Management, VAMC Albany, 113 Holland Ave, Albany, NY 12208, e-mail: *barbara.bates@va.gov*. Reprints are not available from the author.

0003-9993/07/8810-00098$32.00/0
doi:10.1016/j.apmr.2007.06.018

Affairs (VA) health care system influences the rate of admission to a specialized inpatient rehabilitation unit after lower-extremity amputation. Adopting the structure-process-outcome model (Donabedian) developed and applied by Hoenig et al[5,6] for stroke rehabilitation, we propose an Amputation Taxonomy of Care with the availability of a specialized rehabilitation unit (SRU), representing the primary structural element studied in our taxonomy.

Based on the Amputation Taxonomy of Care, our study distinguishes among 3 treatment process groups within the rehabilitation continuum: (1) veterans who have no evidence of a rehabilitation assessment while hospitalized, (2) veterans who have evidence of generalized rehabilitation through consultation level services only while hospitalized, and (3) veterans who have evidence of specialized rehabilitation through SRU admission after their amputation surgery. The treatment process is tracked by the entrance into the rehabilitation continuum. This occurs when patients receive an initial consultation intended to address basic access to rehabilitation. If a patient receives consultation level services only, the rehabilitation level is categorized as generalized rehabilitation. These patients, at a minimum, have an initial functional assessment completed and may, or may not, receive therapy services as a result. If the patient is referred for more intensive rehabilitation and is admitted to an SRU, then he/she is assigned to the specialized rehabilitation group (table 1).

We assumed that the presence of rehabilitation specialists practicing on an SRU within the Veterans Affairs medical center (VAMC) would encourage a cultural shift toward greater awareness of rehabilitation and would drive patients into and through the rehabilitation continuum influencing patterns of patient referral to rehabilitation services. We hypothesized that patients who have surgical amputations in a VAMC that also has an SRU would be more likely to have an initial consultation while still on an acute unit. Among those evaluated by rehabilitation professionals during their surgical hospitalization, we further hypothesized that those treated in facilities with an SRU compared with those without a unit would be more likely admitted for higher intensity rehabilitation to the SRU.

METHODS

This study was approved by the University of Pennsylvania Samuel S. Stratton VAMC, and Kansas City VAMC institutional review boards.

Study Sample

A total of 2912 surgical amputation admission records to all VAMCs with acute hospital discharge dates between October 1, 2002, and September 30, 2003, were included in this study. Four hundred forty-nine duplicate records were removed, as well as 88 patients who had amputations that involved toes only or who had a record of a previous lower-extremity amputation within the 12 months preceding the index surgical stay, in order to obtain a more homogeneous sample with similar clinical characteristics. The hospitalization at the time of the surgical amputation represented the "index surgical stay." There were 2375 admissions for transtibial, transfemoral, or hip disarticulation amputations that were captured using *International Classification of Diseases, 9th Revision, Clinical Modification* (ICD-9-CM) codes 84.10, 84.13 to 84.19, and 84.91, consistent with those used in other studies.[7]

Description of Databases

We used the VA Patient Treatment File (PTF) inpatient database to capture patient demographic information, including age, sex, marital status, source of hospital admission, and diagnoses relevant to the full hospitalization. The VA PTF surgery database was used to obtain the surgical amputation date, which defined the surgical index stay and the surgical diagnoses, which were used as inclusion criteria of veterans with transtibial, transfemoral, or hip disarticulation amputations to determine the amputation level. The VA PTF bed section database contained information on each treating bed section that captured length of hospitalization while patients received care. Total length of stay (LOS) included the sum of surgical, medical, surgical intensive care unit (ICU), medical ICU, and psychiatric bed sections. We excluded SRU rehabilitation, spinal cord injury unit, and extended care bed sections when calculating the total length of hospitalization because we were interested in acute care patterns across VAMCs, and patients in these 3 bed sections have more chronic ailments and longer hospital stays that may be unrelated to their lower-extremity amputation. Patients typically had multiple bed section records per hospitalization that were associated with the index surgical stay. These records were summed if the bed section admissions were within 24 hours of inpatient discharge, creating a single episode of care.

The VA Outpatient Care File (OPC) database captured diagnoses that fell within 90 days preceding the index surgical stay. Patients may have had multiple outpatient records that fell within the 90-day period preceding the hospital admission.

The VA Functional Status and Outcomes Database (FSOD) contains information on date of rehabilitation admission, rehabilitation treatment type, rehabilitation treatment level, and functional status using the FIM instrument, and it provides the VA the ability to track patient functional outcomes irrespective of the venue in which rehabilitation services are provided. The

Table 1: Definitions of Levels and Processes of Rehabilitative Care

Level of Care Terminology*	Description
No evidence of acute rehabilitation	Represents the cohort of patients who have no evidence of hospital-level, generalized consultative, or specialized services associated with their amputation within the first postoperative year.
Generalized rehabilitation	Represents a cohort of patients who have evidence of at least 1 rehabilitation assessment during their index surgical stay. Therapy services may be provided while the patient is located on an acute med/surgical unit or in a long-term care unit, but there is no evidence of an integrated or coordinated approach to rehabilitation.
Specialized rehabilitation	Represents a cohort of patients who have evidence of high-intensity, comprehensive rehabilitation during their index surgical stay defined as admission to a specialized rehabilitation unit accredited by the Commission on Accreditation of Rehabilitation Facilities.

*Receipt of an initial rehabilitation assessment: a process involving entry into the rehabilitation continuum, whereby patients receive at least 1 rehabilitation consultant during their hospitalization. Based on this assessment, patients may be admitted to an SRU and thus enter into the specialized rehabilitation cohort. Those who are not admitted to an SRU make up the generalized rehabilitation cohort.

date of first assessment in the FSOD corresponds to the patient's entry into the rehabilitation continuum. Continuum entry can occur before and/or after the surgical date. For this study, if a veteran had multiple rehabilitation episodes associated with the surgical hospitalization, we applied the first FSOD admission record to obtain initial cognitive and motor functional status.

Creation of Analytic Files for Analysis

Two analytic files were developed, merging data from the PTF, OPC, and FSOD data sources. The first included all 2375 surgical amputation admissions in the study. We used this analytic file to address the likelihood of patients entering the rehabilitation continuum, according to whether or not they had their amputations at VAMCs with an onsite rehabilitation unit. This expressed the likelihood of the patients receiving an initial rehabilitation consultation. The second analytic file represented a subset of patients included in the larger analytic file and was limited to the 1775 patients who were seen by rehabilitation consultants, that is, limited to those patients who entered the rehabilitation continuum. It added additional functional status information from the FSOD, which is collected only for those patients who enter the rehabilitation continuum. We used this data set to address the likelihood of admission to an SRU for patients receiving generalized rehabilitation.

Measures of Patient Case Mix

We compared patient characteristics across the 3 groups. Patient demographics included age, sex, and marital status, defined as married or not married. Location of the patient prior to the surgical hospitalization included 3 categories: extended care, hospital, and home. Levels of amputation were transtibial, transfemoral, and hip disarticulation.

Amputation etiology categories were developed by literature consensus.[8-11] The diagnoses were obtained from the PTF inpatient database and were grouped into 11 etiologic categories.[12] Congenital deformity (1 case) and lower-extremity cancer (0 cases) were not analyzed because of insufficient prevalence. The categories were intended to recognize limb loss as multifactorial. For example, a patient could have both trauma and diabetes mellitus contributing to limb loss. Consequently, patients' reasons for amputation were not classified into mutually exclusive and exhaustive groups.

Comorbid medical diagnoses were expressed by using 2 separate comorbidity measures: the Elixhauser measure[13] and the Charlson/Deyo Index.[14] The Elixhauser measure was applied as the primary comorbidity measure in this study because it includes a broader array of diagnostic categories (31 conditions) than the more commonly reported Charlson (17 conditions), and it has been shown to more accurately predict mortality.[15-17] The Charlson/Deyo Index was also analyzed because it incorporates certain diagnoses not included in the Elixhauser and because certain diagnostic categories are defined by somewhat different lists of ICD-9-CM codes. Our objective was to optimize our adjustment for case-mix differences between the patients with amputations treated in centers with and without onsite SRUs. Contributing etiological conditions such as diabetes mellitus and problems with peripheral circulation were removed from the comorbidity measures because they were already counted as etiologies. Obesity was not analyzed because no case was coded with this condition.

Measure of Structure

We examined how the presence or absence of an SRU onsite within treating VAMCs influenced the rehabilitation services patients received by using the Commission on Accreditation of Rehabilitation Facilities accreditation as criteria to classify centers into those with and without an SRU. The presence versus absence of an SRU was expressed as the primary independent variable after adjusting for patient characteristics and clinical severity.

Measure of Care Process

Acute care utilization. Average medical and surgical LOS, average medical ICU and surgical ICU LOS, and average total LOS were calculated.

Levels of rehabilitation care. As noted previously, we defined 3 levels of service: no evidence of rehabilitation, generalized rehabilitation through consultation only, and specialized rehabilitation evidenced by an SRU admission. Evidence of entry into the rehabilitation continuum was based on the patients' receipt of at least an initial consultation. Patient cohorts were assigned using information from the 2 analytic files described above. In the first analytic file, evidence of rehabilitation was expressed as a dichotomous variable. No evidence of rehabilitation was defined as the lack of an FSOD record, and receipt of an initial consultation was noted with the presence of FSOD record(s). The specialized and generalized consultation rehabilitation levels were defined in the second analytic file. These levels were expressed as a dichotomous variable characterizing the receipt of higher intensity rehabilitation through SRU admission versus lower-intensity generalized consultation only where there were FSOD records present but no SRU admission.

Statistical Analyses

Descriptive statistics were used to test demographic characteristics of patients who received amputations in VAMCs with and without SRU beds. Chi-square analyses and Student *t* tests were used to test differences between patients treated at VAMCs with and without designated beds and rehabilitation care process outcomes. A *P* value of less than .05 was considered statistically significant for all comparisons. In addition to estimating simple proportions, a set of unadjusted odds ratios (ORs) with 95% confidence intervals (CIs) were calculated. OR analyses were designed to investigate 2 questions. The first was the degree to which the presence of rehabilitation with an onsite unit within the VAMC was associated with admission to the continuum. In this analysis, the adjusted OR compared the likelihood of finding evidence of at least an initial rehabilitation consultation among patients in systems with and without onsite SRU beds controlling for case-mix characteristics. In the second analysis incorporating functional status data, the adjusted OR compared the likelihood of receiving higher intensity specialized inpatient rehabilitation versus lower-intensity generalized rehabilitation, comparing patients in systems with and without onsite SRU beds while controlling for case-mix characteristics.

We adjusted the OR for potentially confounding sociodemographic and clinical characteristics. Each of the 2 treatment process-level variables served as dependent variables in multivariable logistic regression models. The primary explanatory variable for these models was the dichotomous VAMC rehabilitation structure-indicator variable (ie, presence or absence of an SRU). Candidate variables for these logistic regression models included age, sex, marital status, source of hospital admission, level of amputation, presence of an SRU, amputation etiological diagnoses, and Elixhauser comorbidities. Model identification began by using 2 domain-specific forward stepwise algorithms in order to identify a parsimonious subset

of variables that sufficiently contained all information in that domain useful for prediction of the outcomes. Variables entered the forward model at *P* equal to .25. The first analysis included: age, sex, marital status, source of hospital admission, level of amputation, presence of an SRU, and amputation etiological diagnoses. The second analysis included age, sex, marital status, source of hospital admission, level of amputation, presence of an SRU, and Elixhauser comorbidities. The variables that were significant in these 2 models were then placed in a backward stepwise regression. Variables were removed from the backward model at *P* equal to .10. The crude OR calculated from the VAMC rehabilitation structure-indicator variable was compared with the adjusted OR for the same variable. The magnitude of differences between the unadjusted and adjusted OR addressed the degree to which discovered associations between VAMC rehabilitation structure type and the treatment process-level outcomes were confounded by clinical factors. The *C* statistic corresponding to the area under the receiver operating characteristic curve was used to assess overall model predictive value.[18] The Hosmer-Lemeshow goodness-of-fit statistic was applied to test fit of the data to the model.[19] Statistical analyses were performed using SAS software.[20,a]

RESULTS

Analysis of the Larger Population of Amputees

Descriptive information regarding the total study population and the subsets of veterans treated at facilities with and without an SRU is shown in table 2. Among the 2375 veterans included in this study, 98.9% were men, and the average age was 67.3 years. The majority of the amputations were transtibial (59.6%), with 39.8% transfemoral and only 0.7% hip disarticulations. Twenty-six patients (1.1%) did not have a record of a surgical or medical bed section. Eighteen of those subjects were on a spinal cord injury service, 7 were on extended care, and a single subject was in an SRU at the time of surgical amputation. Problems with peripheral circulation, diabetes mellitus, significant local infection, and skin breakdown were the most common conditions contributing to limb loss among veterans undergoing surgical amputations in VAMCs. Trauma was a relatively infrequent contributing factor, present in just over 10% of amputees at both types of centers.

There were a total of 125 VA facilities, with 31 having a designated SRU. Nine hundred sixty-six (40.7%) patients were treated in a VAMC with an onsite SRU. There were no statistically significant differences between patients who were seen at centers with and without an SRU with respect to age, sex, marital status, source of hospital admission, or level of amputation (table 3). Patients seen at VAMCs with an SRU had longer average total LOS (24.1d vs 19.4d, respectively, $P<.01$) and LOS in medical and surgical bed sections (19.5d vs 16.1d, respectively, $P<.01$) compared with patients seen at facilities without an SRU; however, there was no statistically significant difference in LOS at medical ICU or surgical ICU bed sections.

There were 1775 amputees (74.7% of the total population) admitted to the rehabilitation continuum in the perisurgical period as ascertained by the presence of an FSOD record. There was no statistically significant difference in the probability of an amputee receiving an initial rehabilitation consultation according to whether or not the treating facility had an SRU ($P=.56$). The unadjusted OR and adjusted OR estimates were similar: 1.06 (95% CI, 0.88–1.28) and 1.1 (95% CI, 0.90–1.34), respectively. The *C* statistic in the multivariable model was .68, and the Hosmer-Lemeshow goodness-of-fit *P* value was not significant.

Problems of peripheral circulation were more common among patients treated in VAMCs without an SRU ($P=.03$),

Table 2: Comparisons of Patient Characteristics and Treatment Process Variables According to the Presence or Absence of an SRU in the Entire Population (N=2375)

Characteristics	Total Population	SRU Present	No SRU	*P*
Patients				
Mean age ± SD (y)	67.3±11.0	67.5±11.2	67.2±10.9	.56
Sex, n (%)				.82
Male	2349 (98.9)	956 (99.0)	1393 (98.9)	
Female	26 (1.1)	10 (1.0)	16 (1.1)	
Marital status, n (%)				.05
Married	1100 (46.3)	424 (43.9)	675 (47.9)	
Not married	1275 (53.7)	542 (56.1)	734 (52.1)	
Source of hospital admission, n (%)				.52
Extended care	264 (11.1)	116 (12.0)	148 (10.5)	
Hospital	81 (3.4)	33 (3.4)	48 (3.4)	
Home	2029 (85.4)	817 (84.6)	1212 (86.1)	
Level of amputation, n (%)				.14
Transtibial	59.6%	592 (61.3)	823 (58.4)	
Transfemoral	39.8%	365 (37.8)	579 (41.1)	
Hip disarticulation	0.7%	9 (0.9)	7 (0.5)	
Treatment process variables				
Mean total LOS ± SD (n=2349)	21.3±35.7	24.1±50.5	19.4±20.3	<.01
Mean LOS ± SD, medical and surgical (n=2310)	17.4±16.2	19.5±18.0	16.1±14.8	<.01
Mean LOS ± SD, medical and surgical ICU (n=954)	8.6±17.0	8.0±12.1	9.2±19.9	.29
FSOD record, n (%)	1775 (74.7)	728 (75.4)	1047 (74.3)	.56
Level of rehabilitation received, n (%)				<.01
No evidence of rehabilitation	600 (25.3)	238 (24.6)	362 (25.7)	
Generalized rehabilitation only	1361 (57.3)	473 (49.0)	888 (63.0)	
Specialized rehabilitation on an SRU	414 (17.4)	255 (26.4)	159 (11.3)	

Abbreviation: SD, standard deviation.

Table 3: Comparisons of Patient Characteristics and Treatment Process Variables According to the Presence or Absence of an SRU in the Subsample Who Entered the Rehabilitation Continuum (n=1775)

Characteristics	Patients Treated at an Site With an SRU Present	Patients Treated at a Site With No SRU	*P*
Patients			
Mean age ± SD (n=1775)	67.1±11.2	66.8±10.8	.69
Sex, n (%)			.78
Male	720 (98.9)	1034 (98.8)	
Female	8 (1.1)	13 (1.2)	
Marital status, n (%)			.07
Married	323 (44.7)	510 (48.7)	
Not married	405 (55.6)	537 (51.3)	
Source of hospital admission, n (%)			.87
Extended care	67 (9.2)	90 (8.6)	
Hospital	21 (2.9)	33 (3.2)	
Home	640 (87.9)	923 (88.2)	
Level of amputation, n (%)			.04
Transtibial	486 (66.7)	656 (62.7)	
Transfemoral	237 (32.6)	389 (37.2)	
Hip disarticulation	5 (0.7)	2 (0.2)	
Rehabilitation services received according to presence of an SRU			
Treatment pattern, n (%)			<.01
Specialized (after surgery only)	243(33.4)	153 (14.6)	
Specialized (before and after surgery)	10 (1.4)	5 (0.5)	
Specialized (before surgery only)	2 (0.3)	1 (0.1)	
Generalized (after surgery only)	426 (58.5)	786 (75.1)	
Generalized (before and after surgery)	44 (6.0)	91 (8.7)	
Generalized (before surgery only)	3 (0.4)	11 (1.1)	
Treatment group, n (%)			<.01
Specialized (SRU)	255 (35.0)	159 (15.2)	
Generalized (consultation only)	473 (65.0)	888 (84.8)	
Mean first cognitive FIM score ± SD	26.2±9.5	27.7±9.4	<.01
Mean first motor FIM score ± SD	38.6±19.6	43.0±20.1	<.01

whereas skin breakdown was listed more frequently in amputees seen at centers with an SRU ($P=.04$). There were no other statistically significant differences between the 2 types of facilities according to amputation etiology (data not included and is available on request).

There were also a few differences in comorbid conditions between patients treated at VAMCs with and without an SRU. Only 2 of 27 conditions, paralysis and hypertension with complication, showed prevalence differences across VAMCs with and without onsite rehabilitation beds ($P<.01$, $P=.04$, respectively). According to the Charlson/Deyo Index, only 1 of 16 conditions (mild liver disease) was more likely to be coded present among patients at VAMCs without an SRU ($P=.02$) (results not shown; data is available on request).

Analysis of the Subpopulation Receiving Rehabilitation Services

Similar to the larger sample, there were no significant differences between patients who were seen at centers with and without an SRU, with respect to age, sex, marital status, or source of hospital admission among patients admitted to the rehabilitation continuum (all $P>.05$) (see table 3). A significantly higher proportion of veterans treated at VAMCs with an SRU were transtibial as opposed to a higher level ($P=.04$). Patients being treated in facilities with SRUs onsite had more severe physical and cognitive disabilities on rehabilitation admission (both $P<.01$).

Four hundred fourteen of the 1775 amputees admitted to the rehabilitation continuum for assessment received specialized inpatient rehabilitation. This represents 23% of those who entered the continuum or 17% of the entire amputee population in this study. Admission to an SRU for higher intensity rehabilitation was strongly related to the presence of onsite beds within the same VAMC as the surgical amputation. Among amputees treated in VAMCs with an onsite rehabilitation unit, 35.1% received specialized rehabilitation as contrasted to 15.2% of those whose surgical amputations occurred in VAMCs without an SRU ($P<.01$). Among those who entered the continuum, the adjusted odds for admission to an SRU was 3.74 (95% CI, 2.92–4.80) times larger if an SRU was present in the same facility in which they received their amputation compared with when no unit was present. The *C* statistic in this multivariable model was .73, and the Hosmer-Lemeshow goodness-of-fit *P* value was not significant.

DISCUSSION

Findings failed to support our first hypothesis that patients whose surgical amputations occurred in VAMCs with an onsite SRU would be more likely to be admitted to the rehabilitation continuum. Rehabilitation consultants (physiatrist, rehabilitation nurse, or rehabilitation therapist) saw three quarters of all veterans with lower-extremity amputations regardless of the presence or absence of an SRU. The finding that veterans with amputations of the lower limb(s) were equally likely to be

evaluated by rehabilitation consultant irrespective of the presence of an SRU in their treating VAMC suggests that access to the rehabilitation continuum is not influenced by the structure of rehabilitation services within the VAMC. These unanticipated findings are a positive outcome of a system-wide quality improvement initiative issued by the Veterans Health Administration to enhance the accountability of rehabilitation services and efficiency of operations across the postacute care continuum. In 2003, as part of the overall quality framework, a rehabilitation performance measure was adopted by the VA's Office of Quality and Performance. This measure required that a functional assessment be completed on veterans admitted to VA facilities with a new amputation. The intent of this functional assessment was to determine the patients' need for rehabilitation services.[21] This specific performance measure is likely driving the practice in the VA of initiating rehabilitation consults postamputation, regardless of where the patient is located. The availability of the FSOD provides an opportunity not found in other health care systems to study these types of referral patterns.

Our findings support our second hypothesis that the presence of designated rehabilitation units within the larger medical center influences process and access among veterans with amputations. Among those assessed, veterans who had their surgical amputations at facilities with onsite SRUs were nearly 4 times more likely to have been admitted to higher intensity specialized rehabilitation. This finding was evident when controlling and not controlling for patient and clinical differences. This higher admission rate does not appear strongly related to case mix differences. Indeed, veterans who received amputations in VAMCs without SRUs were clinically quite similar to those who had their surgical amputations at VAMCs with SRUs as confirmed by the remarkably comparable diagnostic mix. The longer medical and surgical bed lengths of hospitalization of amputees treated in VAMCs with onsite rehabilitation beds suggest either that patients were clinically more severe (and the severity was not captured by the variables available) or that they received more complicated procedures that lengthened their stays. Longer total LOSs in facilities with SRUs also reflect the time spent waiting for an available bed on an SRU or the time being treated in the SRU. ICD-9-CM codes provide information about diagnoses but measure degree of severity poorly. Level of amputation, a good approximation of limb ischemia, is also affected by local surgical practices and decision making. It is noteworthy that there was a trend toward more distal amputations at VAMCs with onsite rehabilitation units. Those VAMCs also tend to be larger centers with presumably more specialized and comprehensive acute care services available.

Our results are consistent with others who have found that the availability of postacute care services, such as inpatient rehabilitation, is a more powerful predictor of postacute care use than the clinical characteristics of many of their models.[22,23]

Overall, 17% of veterans who underwent a lower-extremity amputation were admitted into an SRU, and of those veterans who were assessed by rehabilitation professionals after their surgeries, 23% were ultimately transferred to an inpatient rehabilitation program. In 2 separate studies, investigators looking at admission to rehabilitation programs after amputation found that rates varied geographically. In the Maryland population, inpatient rehabilitation was uncommon after a lower-extremity amputation, where only 12% of patients with dysvascular amputations were discharged from acute care into inpatient rehabilitation (using 1997 results),[3] whereas in Massachusetts, the rate was 16% for that same year.[4] Neither study included data from VA hospitals. Moreover, over the past several years, there has been approximately a 10% decline in specialized rehabilitation admission rates in the private sector. In 2004, less than 8% of patients with amputation of the lower extremity were discharged from SRUs,[24,25] which is even lower than the rate for VAMCs without onsite SRUs in our study (11%) implying treatment disparities both between the VA and private sectors and within the VA. It is possible that the higher rates of discharge from SRUs in the VA are the result of the VA national performance measures driving the practice of obtaining at least an initial functional assessment of large numbers of veterans with amputations. With that initial assessment, greater numbers of patients may be identified as needing the higher-intensity focus of an inpatient rehabilitation program.

The assessment of rehabilitation potential involves addressing candidacy for various levels of rehabilitation. A transtibial or transfemoral amputation does not presuppose rehabilitation need. It is rather the manifestations of any number of diagnoses and the combination of these diagnoses in conjunction with environmental factors that drive the need for particular types and intensities of rehabilitation. By requiring, at a minimum, an initial rehabilitation assessment after amputation surgery, the VA is helping to ensure that all veterans with a lower-extremity amputation have at least the opportunity to be evaluated for their ongoing rehabilitation needs. In all likelihood this would lead to provision of therapy services, if not necessarily specialized inpatient rehabilitation care. Specialized rehabilitation treatment has been shown to be effective among stroke patients in terms of process and outcomes.[26,27] More intensive rehabilitation treatment could be effective in our amputee population; however, future studies are needed to confirm this. Clinical traits that are both statistically and clinically important determinants of rehabilitation need should be used in deciding on the use of expensive resources such as an SRU. Higher rates of SRU use within the VA do not necessarily imply optimal use of services. Availability of rehabilitation services, although strongly predictive of receiving that service, is distinct from the clinically important factors that should be driving the decision-making process. Additional studies are needed to fully understand the benefits of SRUs and to ensure the best possible identification of the patients who would most benefit from that level of care.

Study Limitations

This study has a number of limitations. Only 3 levels of rehabilitative care were addressed. The full rehabilitation continuum encompasses home care and outpatient care, and future studies need to consider referral processes within and through all levels of rehabilitation. Additionally, the study was limited to veterans, and the results may not be applicable to the larger U.S. population. Because this study was not a randomized trial, causality cannot be inferred. Yet the findings make intuitive sense. Moreover, our structure and process variables were global. The presence versus absence of an SRU at the VAMC where amputation occurred implies greater accessibility of high-level rehabilitation services but says nothing about the contents of those services or their influence on patient outcomes. In addition, patients who did not receive inpatient rehabilitation treatment evidenced by an FSOD record from the VA may have sought treatment in the private sector. However, with only VA data available to us, we were unable to compare outcomes between VA and non-VA rehabilitation patients. Further studies with a more comprehensive perspective will be essential to address all the components of services within the rehabilitation continuum with regard to their influence on patient outcomes. Moreover, it will be essential to determine if

lack of easy access to specialized rehabilitation beds is generating similar service disparities in Medicare supported hospitals within the private sector. Without operation of the performance indicator formally addressing the need for rehabilitation services, it would be reasonable to assume that access disparities would be even greater.

CONCLUSIONS

The presence of an SRU within a larger medical center does not impact consultation rates for rehabilitation within the VA, but does affect admission to the specialized unit for veterans with lower-extremity amputations. The structure of rehabilitation services strongly influences the intensity of rehabilitation services received once patients enter the continuum. Future studies of outcome differences across generalized consultation only and specialized rehabilitation services are essential in addressing the implications of these findings. Clinicians need to recognize that the presence or absence of SRUs may influence referral patterns in ways that are not clinically equitable.

Acknowledgment: The opinions and conclusions of the authors are not necessarily those of the sponsoring agencies.

References

1. Fletcher D, Andrews K, Hallett J, Butters M, Rowland C, Jacobsen S. Trends in rehabilitation after amputation for geriatric patients with vascular disease: implications for future health resource allocation. Arch Phys Med Rehabil 2002;83:1389-93.
2. Pezzin LE, Dillingham TR, MacKenzie EJ. Rehabilitation and the long-term outcomes of persons with trauma-related amputations. Arch Phys Med Rehabil 2000;81:292-300.
3. Dillingham TR, Pezzin LE, MacKenzie EJ. Discharge destination after dysvascular lower-limb amputations. Arch Phys Med Rehabil 2003;84:1662-8.
4. Dillingham TR, Pezzin LE. Postacute care services use for dysvascular amputees. Am J Phys Med Rehabil 2005;84:147-52.
5. Hoenig H, Duncan PW, Horner RD, et al. Structure, process, and outcomes in stroke rehabilitation. Med Care 2002;40:1036-47.
6. Hoenig H, Horner RD, Duncan PW, Clipp E, Hamilton B. New horizons in stroke rehabilitation research. J Rehabil Res Dev 1999;36:19-31.
7. Mayfield JA, Reiber GE, Maynard C, Czerniecki JM, Caps MT, Sangeorzan BJ. Survival following lower-limb amputation in a veteran population. J Rehabil Res Dev 2001;38:341-5.
8. Dillingham T, Pezzin L, MacKenzie E. Limb amputation and limb deficiency: epidemiology and recent trends in the United States. South Med J 2002;95:875-83.
9. Mayfield JA, Reiber GE, Maynard C, Czerniecki JM, Caps MT, Sangeorzan BJ. Trends in lower limb amputation in the Veterans Health Administration, 1989-1998. J Rehabil Res Dev 2000;37:23-37.
10. Collins TC, Beyth RJ. Process of care and outcomes in peripheral arterial disease. Am J Med Sci 2003;325:125-34.
11. Dillingham TR, Pezzin LE, MacKenzie EJ. Incidence, acute care length of stay, and discharge to rehabilitation of traumatic amputee patients: an epidemiologic study. Arch Phys Med Rehabil 1998;79:279-97.
12. Bates B, Stineman MG, Reker D, Kurichi J, Kwong PL. Risk factors associated with mortality following trans-tibial or transfemoral amputation. J Rehabil Res Dev 2007;43:917-28.
13. Elixhauser A, Steiner C, Harris DR, Coffey RM. Comorbidity measures for use with administrative data. Med Care 1998;36:8-27.
14. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chronic Dis 1987;40:373-83.
15. Southern DA, Quan H, Ghali WA. Comparison of the Elixhauser and Charlson/Deyo methods of comorbidity measurement in administrative data. Med Care 2000;42:355-60.
16. Stukenborg GJ, Wagner DP, Connors AF. Comparison of the performance of two comorbidity measures, with and without information from prior hospitalizations. Med Care 2001;39:727-39.
17. Deyo R, Cherkin D, Ciol M. Adapting a clinical comorbidity index for use with ICD-9-CM administrative databases. J Clin Epidemiol 1992;45:613-9.
18. Hanley JA, McNeil BJ. The meaning and use of the area under a receiver operating characteristic (ROC) curve. Radiology 1982;143:29-36.
19. Hosmer DL. Applied logistic regression. New York: John Wiley & Sons; 1989.
20. Statistical Analysis Software [computer program]. Version 9.1. Cary: SAS; 2003.
21. VHA Office of Quality Improvement. Available at: http://www.oqp.med.va.gov. Accessed January 11, 2007.
22. Kane RL, Lin WC, Blewett LA. Geographic variation in the use of post-acute care. Health Serv Res 2002;37:667-82.
23. Buntin MB, Gartin AD, Paddock S, Saliba D, Totten M, Escarce JJ. How much is postacute care use affected by its availability? Health Serv Res 2005;40:413-34.
24. Moran Company. Utilization trends in inpatient rehabilitation: update through QII 2006. Arlington: Moran Co; Sept 2006.
25. Agency for Healthcare Research and Quality. HCUP Nationwide Inpatient Sample. Available at: http://www.hcup-us.ahrq.gov/toolssoftware/comorbidity/comorbidity.jsp#variables. Accessed January 11, 2007.
26. Hoenig H, Sloane R, Horner RD, Zolkewitz M, Reker D. Differences in rehabilitation services and outcomes among stroke patients cared for in Veterans hospitals. Health Serv Res 2001;35:1293-318.
27. Hoenig H, Sloane R, Horner RD, Zolkewitz M, Duncan PW, Hamilton BB. A taxonomy for classification of stroke rehabilitation services. Arch Phys Med Rehabil 2000;81:853-62.

Supplier

a. Version 9.1; SAS Institute Inc, 100 SAS Campus Dr, Cary, NC 27513.