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Trends in lower limb amputation in the Veterans Health Administration, 1989-1998

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Abstract—Objective: To assess trends in lower limb amputation performed in Veterans Health Administration (VHA) facilities.

Methods: All lower limb amputations recorded in the Patient Treatment File for 1989–1998 were analyzed using the hospital discharge as the unit of analysis. Age-specific rates were calculated using the VHA user-population as the denominator. Frequency tables and linear, logistic, and Poisson regression were used respectively to assess trends in amputation numbers, reoperation rates, and age-specific amputation rates. Results: Between 1989–1998, there were 60,324 discharges with amputation in VHA facilities. Over 99.9% of these were in men and constitute 10 percent of all US male amputations. The major indications were diabetes (62.9%) and peripheral vascular disease alone (23.6%). The age-specific rates of major amputation in the VHA are higher than US rates of major amputation. VHA rates of major and minor amputation declined an average of 5% each year, while the number of diabetes-associated amputations remained the same. Conclusion: The number and age-specific rates of amputations decreased over 10 years despite an increase in the number of veterans using VHA care.

Key words: *amputation epidemiology.*

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INTRODUCTION

The veteran with amputation has always attracted special attention, serving as a visible reminder of the personal sacrifice of armed conflict. However, in an aging veteran population, amputation of the lower limb is much more likely to occur as a complication of peripheral atherosclerotic vascular disease (ASVD) or diabetes. Amputation of the lower limb has serious implications for the functional status, well-being, and survival, particularly for the older individual. Thus, it is no surprise that amputation prevention has received increased attention in the Veterans Health Administration (VHA) over the last decade as part of an overall quality improvement effort to better the health and functional status of an aging veteran population.

In 1992, a special VHA Directive (10-93-092, reaffirmed in Directive 10-96-007) established the *Preservation, Amputation Care and Treatment (PACT) Program,* mandating a multidisciplinary team at each facility to "track every patient with amputations, and those at risk for limb loss, from the day of entry into the VA health care system, through all appropriate care levels, back into the community." Two national educational conferences were organized, accompanied by an educational video tape and pamphlets for patients and providers on effective strategies to reduce amputation risk.

Little information is available, however, on the effectiveness of these efforts. The most recent reports of

Table 1.
Number of hospital discharges with lower limb amputation by year and amputation indication, Veterans Health Administration, 1989-1998.

			Indication*			
Year	DM	ASVD	Misc	Trauma	Cancer	Total
1989	3,816	1,172	895	120	33	6,585
1990	3,951	1,692	810	102	21	6,576
1991	3,663	1,492	734	104	28	6,021
1992	3,593	1,431	667	84	19	5,794
1993	3,856	1,467	706	80	23	6,130
1994	3,915	1,406	655	100	20	6,096
1995	3,920	1,388	700	68	21	6,097
1996	4,065	1,301	579	95	12	6,052
1997	3,665	1,223	683	55	18	5,644
1998	3,481	1,135	630	61	22	5,329
Total	37,923	14,256	7,059	869	217	60,324

*Indication assigned to only one category in the following algorithm: ASVD < diabetes < major trauma < cancer < miscellaneous; DM=diabetes; ASVD=peripheral atherosclerotic vascular disease; Misc=miscellaneous; Trauma=major trauma.

VHA amputations are now over 30 years old (1,2), so little is known as to the impact of this directive upon the amputation rate within VHA. Consequently, we undertook an analysis of amputations performed in the VHA hospitals from 1989–1998 to assess the impact of the PACT directive and better understand the current epidemiology of lower-limb amputation in veterans.

METHODS

Discharge records contained in the Patient Treatment File from all VHA hospitals between fiscal years (FY) 1989 and 1998 were obtained. This file permits up to five codes for each operation and up to ten diagnoses codes for the hospitalization. Eleven diagnosis codes were available for 1997 and 1998 data. The quality of this data set has been validated (3).

All discharges with amputation of the lower limb (ICD-9-CM 84.11 to 84.19 were identified and grouped into toe (ICD-9-CM 84.11), transmetatarsal (ICD-9-CM 84.12), transtibial (ICD-9-CM 84.13-84.17), and transfemoral (84.18-84.19) amputations. Multiple procedures with the same ICD-9-CM code on the same day were considered to be a single amputation, even though they might represent bilateral amputations. Two amputation codes during the same operation were probably bilateral amputations, but were assigned as a single procedure at the most proximal level. Revisions of residual limb (ICD-9-CM 84.3), defined as a repeat operation at the same amputation level, were identified separately from the amputation procedures. Approximately 15 percent of the discharges recorded two or more amputations during the hospitalization, thus the most proximal level was used for the hospital-level analysis. A scrambled social security number for each individual allowed aggregation of all hospitalizations for an individual over time.

The indications for the amputation were assigned to a single group using the following hierarchical algorithm:

a. ASVD: non-specific atherosclerosis (ICD-9-CM 440.x, 44x.x) peripheral vascular disease (ICD-9-CM 443.8, 443.89,440.21), rest pain or ulcer due to atherosclerosis (ICD-9-CM 440.22, 440.23), gangrene due to atherosclerosis or complications of a prior vascular graft (ICD-9- CM 440.3, 996.62, 996.7, 996.74, E878.2).

b. Diabetes: Any diabetes codes (ICD-9-CM 250.x) regardless of peripheral vascular disease status.

c. Major trauma of the lower limb: traumatic amputation (ICD-9- CM 895.x-897.x), fracture or late effect of fracture (ICD-9-CM 82x, 905.4), dislocation (ICD-9-CM 835-838), or crush injury (ICD-9- CM 928-929) regardless of any other diagnosis.

d. Cancer of the lower limb (ICD-9-CM 170.7, 170.8, 172.7, 173.7) regardless of any other diagnosis.

e. Miscellaneous: comprised a group with diagnosis codes not included in any of the above groups. These included non-infected ulcers (ICD-9-CM 707.0, 707.1,

707.9,891-894), superficial infection (681.10, 681.11, 682.6, and 682.7), deep infection, fasciitis, osteomyelitis (ICD-9-CM 729.4, 730.x, 731x), nonspecific gangrene or gas gangrene (ICD-9-CM 785.4 and 040.0) and complications of prior surgery (residual limb infection or amputation complications) (ICD-9-CM 768, 997.6).

For example, a person with both peripheral vascular disease and diabetes would be coded as "diabetes," but if a crush injury of the limb were also listed, the indications for the amputation would be coded as "major trauma."

Age-specific amputation rates were calculated using the unduplicated VHA user population, defined as veterans with one or more registered outpatient visits at a VA facility during the FY, each veteran being counted only once. Frequency tables were used to describe the characteristics of those who underwent amputation, vascular bypass and angioplasty. Statistical significance was tested with Pearson's chi-square test. Trends in continuous variables (amputation number) were tested using linear regression, trends in dichotomous outcomes (i.e., re-operation) were tested with logistic regression, and trends in rates (i.e., amputation) were tested with Poisson regression.

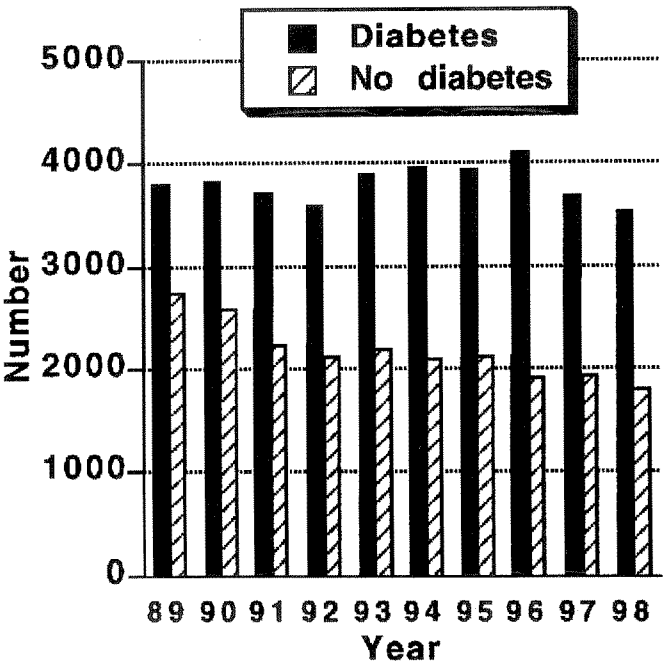

Figure 1.
Total discharges with lower limb amputation by diabetes status, VHA, 1989-1998.

RESULTS

Between FY 1989 and 1998, 70,200 amputations were performed during 60,324 hospitalizations on 44,007 veterans (data not shown). The number of hospitalizations with amputation by amputation indication are shown in **Table 1**. Diabetes-associated amputations were the most frequent indication, comprising 62.9 percent of all amputation discharges. ASVD was the next most common indication, comprising 23.6 percent. Miscellaneous conditions (which included ulcers without diabetes or ASVD) was the third most common grouping of indications, at 11.7 percent; major trauma was identified in 869 hospitalizations (1.4 percent), and cancer of the lower limb in 217 persons, comprising only 0.4 percent of all amputations.

The most proximal amputation level, demographic features, and comorbid conditions by amputation indication for hospital discharges are shown in **Table 2**. Almost 30 percent of the hospital discharges are at the transfemoral level, approximately a quarter are transtibial, and the remaining 44 percent were at the transmetatarsal or toe level. Over 40 percent of the amputations were performed upon veterans between the ages of 65 and 74 years, with the age ranging from 26 to 106 years of age. Twenty-four percent were African-American, 63.1 percent were Caucasian, and 12.8 percent were of other or unspecified race. Over 99 percent of the patients were male, half were married, and two-thirds had diabetes.

Approximately 15 percent of the discharges recorded two or more amputation procedures during the same hospitalization and 24 percent had another hospital discharge with amputation during the same year (data not shown). In addition, 10,146 residual limb revisions, defined as a revision at the same amputation level, were performed over the 10 years. Residual limb revisions occurred during the same hospitalization as the amputation. Fifty seven percent of all the residual limb revisions were in persons with diabetes, 23 percent in those with ASVD, 19 percent in those with miscellaneous conditions, and 1 percent in cancer or major trauma patients.

The 10-year trends were analyzed. The total number of amputations by diabetes status over that period is shown in **Figure 1**. The number of discharges with any lower limb amputation decreased by a mean of 80 discharges per year ($p=0.017$). Most of the decrease came from a decline in discharges with major amputations, with a mean decline of 74 discharges per year ($p=0.000$), while discharges with

Table 2.
Level of amputation, comorbid conditons, associated procedures, and demographic characteristics by amputation indication, column percent, VHA, FY 1989-1998.

	Indication for Amputation (by percent)					
	DM	**ASVD**	**Misc**	**Trauma**	**Cancer**	**Total**
Amputation Level*						
Toe	41.8	18.6	35.0	41.0	24.9	34.8
Transmetatarsal	10.7	4.7	7.0	4.8	14.7	8.8
Transtibial	28.6	24.8	22.8	26.6	19.8	27.0
Transfemoral	19.9	51.9	35.2	27.6	40.6	29.4
Total	100.0	100.0	100.0	100.0	100.0	100.0
Associated Procedures**						
≥2 amputations	16.0	14.8	7.6	11.0	2.8	14.6
Vascular procedure	12.0	20.8	2.4	5.9	1.4	12.8
Comorbid Conditions						
ASVD	51.6	100.0	0.0	30.5	5.1	56.5
Renal disease	11.7	6.8	5.1	4.4	2.3	9.6
Age						
<44 yrs	2.8	2.6	11.1	13.2	9.2	3.8
45-54 yrs	11.0	6.9	13.6	14.2	11.5	10.4
55-64 yrs	30.0	23.3	21.5	23.9	29.0	27.4
65-74 yrs	41.4	43.3	34.4	32.7	34.6	40.9
75-84 yrs	13.5	20.1	16.1	14.2	12.9	15.4
85+ yrs	1.2	3.8	3.3	1.8	2.8	2.1
Total	100.0	100.0	100.0	100.0	100.0	100.0
Race						
Black	23.1	26.2	26.1	16.6	14.8	24.1
White	61.6	64.7	66.4	72.8	73.7	63.1
Other/Unspecified	15.2	9.1	7.5	10.6	11.5	12.8
Total	100.0	100.0	100.0	100.0	100.0	100.0
Married	51.8	42.1	42.1	47.5	49.8	48.3

DM=diabetes; ASVD=peripheral atherosclerotic vascular disease; Misc=miscellaneous; Trauma=major trauma; for numbers in each category, see **Table 1**; *indication assigned to only one category in the following algorithm: ASVD < diabetes < major trauma < cancer < miscellaneous and unspecified; **performed during the same hospitalization.

minor amputation declined by only a mean of 6 discharges per year (p=0.708). Most of the decrease came from a decline in discharges without diabetes, with a mean decline of 68 discharges per year, while discharges with diabetic amputations (both major and minor) declined by only a mean of 12 discharges per year (p=0.588). This resulted in diabetes-associated amputations comprising an ever-increasing proportion of total amputations over the decade.

Several other findings differed by diabetes status. Persons with diabetes were more likely to undergo two or more amputations during the hospitalization as compared to persons without diabetes as shown in **Figure 2**. However, the percent of discharges with two or more amputations during the hospitalization declined steadily for both groups, decreasing from 12 percent to 7.7 percent over the 10 years (p=0.000). The number of residual limb revisions decreased by 25 per year (p=0.011) and did not differ by diabetes status.

Between 1989 and 1998, the total user population (veterans with one or more outpatient visits) increased an average of 63,231 veterans per year (p=0.000). This user population was used to calculate age-specific amputation rates shown in **Figure 3**. These rates for persons 45–65 years of age and those over 75 years of age declined steadily

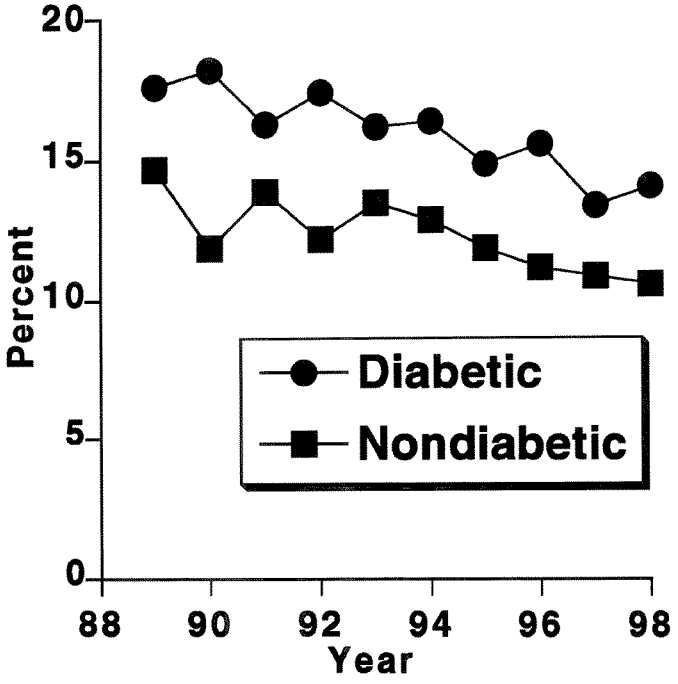

Figure 2.
Percentage of persons with two or more amputation procedures during the hospitalization by diabetes status, VHA, 1989-1998.

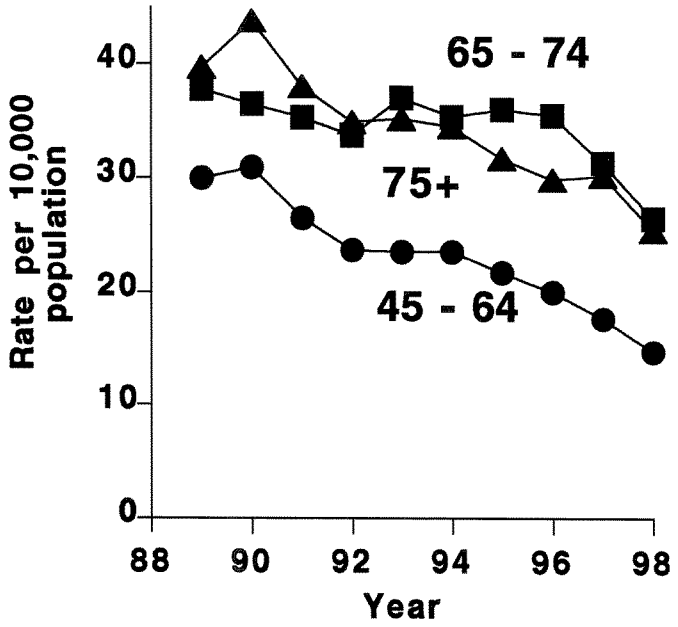

Figure 3.
Age-specific rates for lower limb amputation, VHA 1989-1998.

over the 10 years, while those for persons 65–74 years of age did not start to decline until after 1996. Poisson regression modeling indicated annual declines of 5.5 percent for the 45–64 group, 3.5 percent for the 65–74 group, and 5.0 percent for veterans 75 years and older.

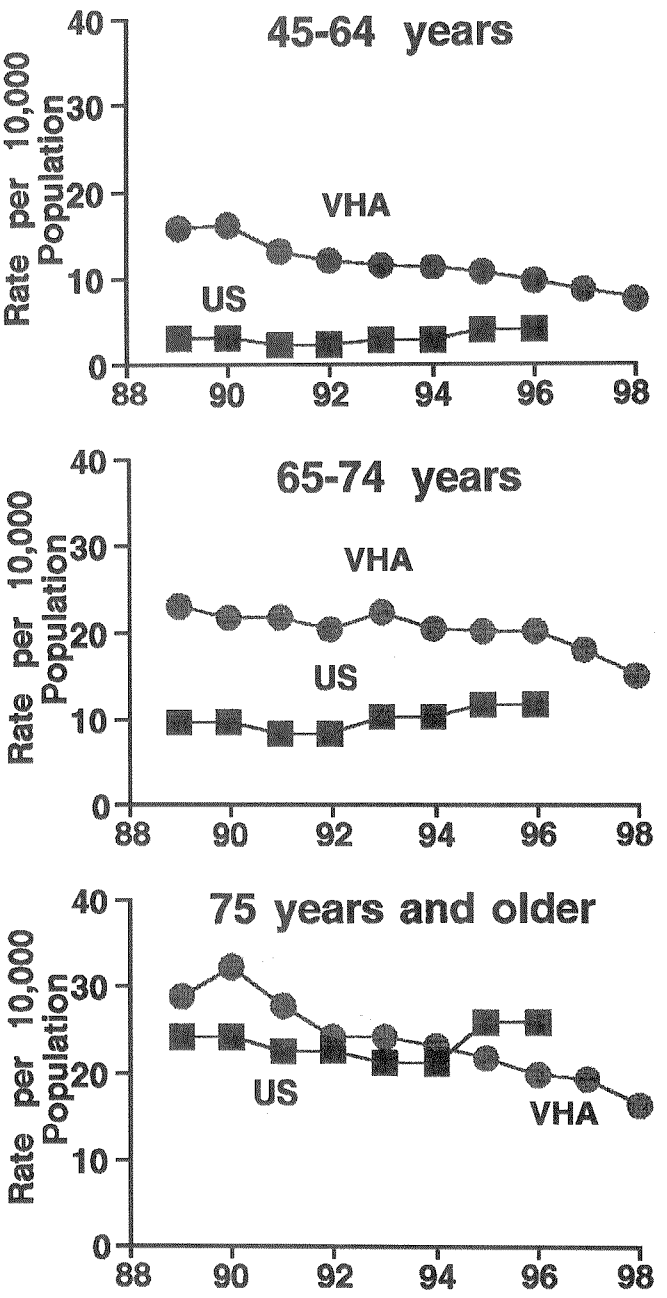

Figure 4.
Age-specific rates for major amputation, VHA and US, 1989-1998.

The age-specific rates for major amputation (transfemoral and transtibial amputation level) for the VHA are compared to US men[1] in **Figure 4**. The VHA rates are significantly higher than those for the US for both the 45–64 and the 65–74 age groups, but the VHA rates steadily

[1] National Hospital Discharge Survey, courtesy of Joel Feinglass. Data from 1997 and 1998 are not available.

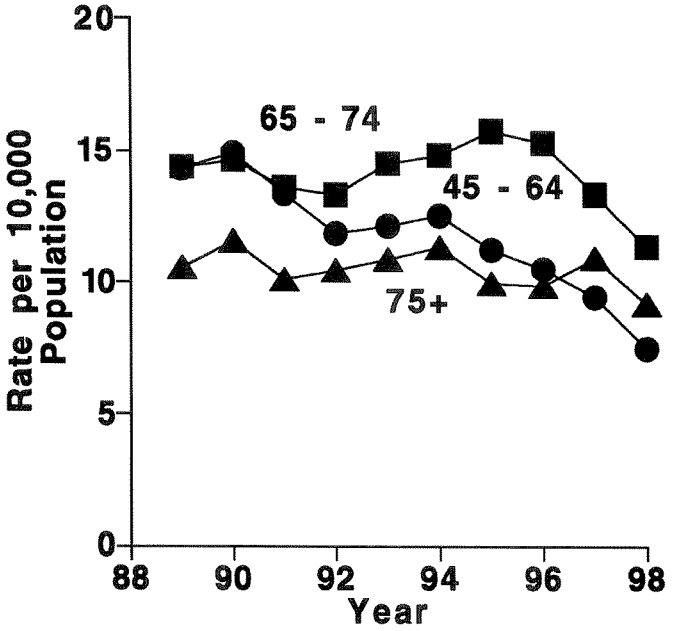

Figure 5.
Age-specific rates for minor amputation, VHA, 1989-1998.

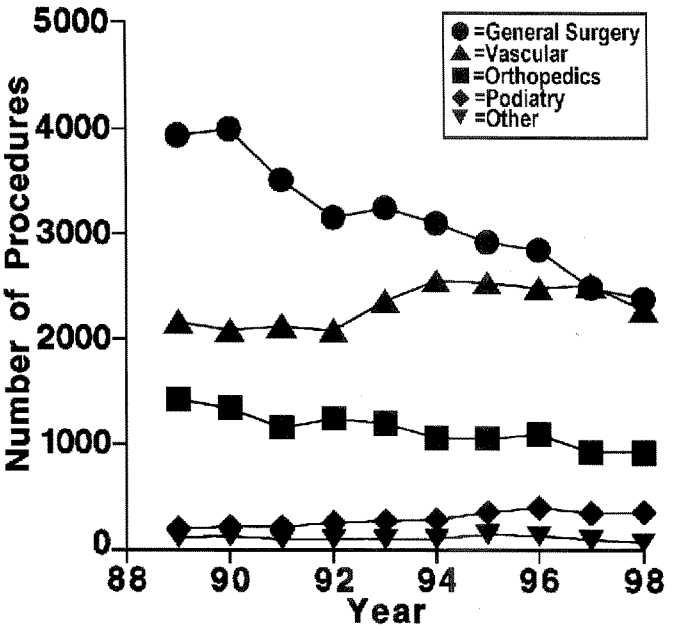

Figure 6.
Number of amputation procedures by surgeon specialty, VHA 1989-1998.

declined while the US rates appear relatively stable. The age-specific rates for those 75 years and older were similar and cross after 1994 as the VHA rates for those 75 years and older steadily decline and the US rates increase.

The age-specific rates for minor amputation (toe and transmetatarsal) show a somewhat different pattern, as depicted in **Figure 5**. Veterans age 65–74 years had a higher amputation rate than did younger (45–64 years) and older (75 years and older) veterans. While the amputation rate declined for all three age groups, those for the 45–64 cohort declined the most.

The trends in the surgical specialty of the primary surgeon performing the operation are depicted in **Figure 6**. The denominator for this graph is total amputations rather than hospital discharges. Three-quarters of primary surgeons were residents and thus were categorized according to their current residency service, while the remaining one-fourth of the primary surgeons were staff or attending physicians. For all procedures between 1989 and 1998, general surgeons performed 44.8 percent, vascular surgeons 32.9 percent, orthopedic surgeons 16.3 percent, podiatrists 4.3 percent and other specialties 1.7 percent. The number of amputations performed by general surgeons declined over the 10 years, while the number of amputations performed by other surgical specialties remained fairly stable.

DISCUSSION

We identified a total of 60,324 discharges with lower limb amputation between 1989 and 1998 in VHA facilities. Over 98 percent of the amputations were associated with chronic disease: diabetes, ASVD, and venous stasis ulceration. Less than 2 percent were due to major trauma or cancer. Although the number of veterans using VHA facilities (i.e., user population) increased over the decade, the total number of amputations declined steadily by about 80 per year. The age-specific amputation rates for those below 65 years and those above 75 years had a mean decline of approximately 5 percent a year, while the age-specific amputation rate for persons 65–74 years of age did not start to decline until 1996, thereby having a smaller mean decline of 3.5 percent per year.

The rates of major amputation in the VHA were considerably higher than the male US rates and show a very different trend over the past decade. There are several explanations for this apparent difference in rates and trends between the VHA and US rates. The US rates are based on the National Hospital Discharge Survey (NHDS), which currently does not include VHA data (4). Thus, the NHDS underestimates the true rate of amputation in US men, because VHA amputations are not included in the numerator but the veteran population is included in the denominator. For example, in 1995 the VHA performed 3,267, and the

non-VA US hospitals performed an estimated 31,211 major amputations on men. Accordingly, the VHA provides 10 percent of all amputations in the US, and the NHDS estimate is approximately 10 percent less than true rate amputations in US males. Nonetheless, this explanation accounts for only a small fraction of the two-fold higher rates seen in the VHA as compared to the general US population.

A likely explanation for the majority of the difference in age-specific amputation rates between VHA and US populations involves the adverse selection of the veteran user population. The user population of the VHA is highly skewed to veterans with chronic illnesses, disabilities, and few financial resources: all characteristics associated with poor outcomes. In fact, we believe the true amputation rate in our veteran user population may be even higher than we report here because we did not capture data on veteran-users who undergo amputation at a non-VHA facilities using Medicare or Medicaid coverage. Prior investigations of dual-use of surgical procedures between VHA and Medicare-reimbursed services for veterans over 65 years of age suggests that approximately 25 percent of nonemergent procedures for the veteran user population are obtained in non-VHA facilities (5).

Of great interest was our improving age-specific rates for major and minor amputation, while major amputation rates in the US have been fairly stable over the last 20 years (4). We would like to believe that the VHA is providing better preventive care resulting in less amputation. The change in rates may also be explained by shifts in the user-population used to calculate these rates. We estimated the VHA user population each year by identifying the unique social security number of every veteran who received ambulatory care during the year. However, the VHA has recently relaxed eligibility criteria, actively recruited veterans to expand enrollment, and increased efforts to accurately capture every patient encounter. These efforts may inflate the user population and bias the results, particularly during 1997 and 1998 when enrollment grew rapidly. Our method of calculating the user population may also underestimate the true user population if many veterans use VHA ambulatory care less than once a year or not at all (the so-called "non-compliant" patient), but are admitted for lower limb amputation in a VHA facility. In a study of 79 diabetic amputees discharged from three VHA facilities in 1994 and 1995, 92 percent indicated that the VHA was their usual source of foot care and 85 percent considered it their usual source for general medical care (6). Better information on dual use between VHA and other insurance programs would strengthen our confidence in both the numerators and denominators used to construct these amputation trends.

Diabetes-associated amputation comprised the largest proportion of amputations in the VHA. The proportion of VHA diabetic amputations is considerably higher than the 50 percent estimated for the general US population (7) and undoubtedly reflects the higher prevalence of diabetes in the VHA population, estimated at least 10–15 percent (8) as compared to the 5–8 percent prevalence estimate in the US population (9). The annual number of VHA discharges with diabetic associated amputation has remained stable over the last 10 years, which has made the percentage of amputations associated with diabetes increase from 59 percent in 1989 to 66 percent in 1998. Obviously, this population deserves more attention and care if preventive efforts are to be successful.

Although the VHA has a long tradition of amputee rehabilitation, amputation prevention is a relatively recent innovation. In 1985, VHA established the Special Teams for Amputation, Mobility, and Prosthetics/Orthotics (STAMP) Program consisting of eight centers of excellence, with funds for extra staff and supplies to improve the quality and availability of services to persons with amputation. Critics complained that the impact was not widespread enough and decried the lack of preventive emphasis, which eventually led to the Preservation, Amputation Care and Treatment (PACT) Program mandate in 1992. The PACT program was to build upon the foundation established by the STAMP program where available, but provided no funds for staff, education, supplies, or evaluation. Amputation data have not routinely been available either to facilities or Veterans Integrated Service Networks (VISNs), and thus local and national PACT coordinators and directors have had little feedback on their efforts. Our analysis represents the first systematic evaluation of amputations performed in VHA facilities in over 30 years and suggests trends not seen elsewhere in the United States.

Our analysis reflects the complex environment under which VHA must improve amputation care. This care is shared by a number of surgical specialties, a situation that increases the difficulty of coordinating quality improvement efforts. About three-quarters of all procedures are performed by a supervised resident, emphasizing the large proportion of caregivers rotating through VHA facilities who must be educated every year to continue quality improvement efforts. Despite these difficulties, the decreasing rates of amputation, repeat amputation procedures during the same hospitalization, and residual limb revisions all suggest better surgical decision-making, post-operative care, and preventive care. Unfortunately, healing and rehabilitation

rates were not available.

Finally, we must emphasize that most amputations do not represent a failure of the patient, provider, or care system. Amputation is often the inevitable toll of advancing disease of the elderly. As veterans age, they are more likely to develop chronic conditions that place the integrity of the lower limb in jeopardy. In many cases a minor amputation results in a successful outcome by returning a frail elderly person rapidly to ambulatory function.

In summary, age-specific amputation rates in the VHA population are higher than the general population and most likely reflect the high prevalence of diabetes and other risk factors in the veteran population. The number of lower limb amputations in veterans is decreasing, despite the increase in eligible users of VHA facilities, providing decreasing age-specific rates of amputation. However, the number of diabetes-associated amputations are stable, suggesting that the current management strategies must be altered to include effective strategies to reduce diabetes-related amputation.

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