The Epidemiology of Lower-Extremity Disease in Veterans With Diabetes

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OBJECTIVE — To describe the epidemiology of lower-extremity complications of diabetes in veterans who are users of the Department of Veterans Affairs (VA).

RESEARCH DESIGN AND METHODS — Hospital discharge records for care provided in all VA hospitals in 1998 were obtained. All hospitalizations for lower-extremity ulceration, peripheral vascular procedures, and amputation were analyzed using frequency tables. A diabetes denominator was defined as a veteran with at least three ambulatory care visits with at least one diabetes diagnosis code. Age-specific and total age-adjusted rates of discharge with ulceration, vascular procedures, and amputation were calculated.

RESULTS — Veterans with diabetes comprised over half of all hospitalizations for lower-extremity ulceration, one-third of all hospitalizations for peripheral vascular procedures, and two-thirds of all hospitalizations for amputation. The age-specific discharge rate per 1,000 diabetic persons for age 0–64 years, 65–74 years, and 75 years and older for ulceration were 28.4, 31.0, and 37.9; for vascular procedures, the rates were 3.5, 4.4, and 4.4; and for amputation, the rates were 7.3, 9.0, and 10.0, respectively.

CONCLUSIONS — Veterans with diabetes comprise a significant proportion of hospitalizations for lower-extremity ulceration, peripheral vascular bypass, and amputation. Age-specific rates of diabetic amputation in veterans are lower than U.S. rates.

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Diabetic complications of the lower extremity include peripheral neuropathy, peripheral vascular disease, and abnormal biomechanics leading to ulceration, amputation, and death. The most costly consequence of these complications involves hospitalization for ulcers, revascularization, amputation, and subsequent rehabilitation. Data from the U.S. National Discharge Survey and the Nationwide Inpatient sample suggest that the number of diabetes-associated amputations increased from 1990 to 1996 and declined when the Centers for Disease Control and Prevention (CDC) modified the diabetes denominator beginning in 1997 (1,2). However, these data do not include care provided within the Department of Veterans Affairs (VA). Thus, we undertook this analysis to describe the epidemiology of lower-extremity ulceration, peripheral vascular procedures, and amputation provided in 1998 by the VA.

RESEARCH DESIGN AND METHODS

— Hospital discharge records from FY1998 were obtained from the VA Patient Treatment File. The quality of this dataset has been validated previously (3). This file permits up to 5 codes for each operation and up to 11 diagnoses codes for the hospitalization. A scrambled social security number for each individual during the year allowed aggregation of all hospitalizations for an individual. Any person with a hospital diagnosis code for diabetes was identified for the entire year as having diabetes (4).

All hospitalizations for lower-extremity ulceration were identified and classified according to most severe diagnosis using the following hierarchy modified from Holzer (5): *1*) chronic nonhealing ulcers (ICD-9-CM 707.1, 707.9); *2*) cellulitis, abscess, or infected ulcer (ICD-9-CM 681.10, 681.11, 682.6, and 682.7); *3*) osteomyelitis (ICD-9-CM 729.4, 730.x, 731.x); *4*) gangrene (ICD-9-CM 785.4, 040.0, and 440.24); *5*) surgical complications from a stump infection (ICD-9-CM 768); *6*) orthopedic procedure (ICD-9-CM 997.6); or 7) complications from a prior vascular graft (ICD-9-CM 440.3, 996.62, 996.7, 996.74, and E878.2). We excluded hospitalizations with venous stasis ulcer codes and no additional specific codes for other lower-extremity conditions. We also excluded the 8,980 hospitalizations for decubiti ulcers (ICD-9-CM 707.0) without concurrent lower-extremity disease because the code provides no specific information on anatomic site.

All peripheral vascular procedures were noted from either the surgery file or the procedure file and classified according to the most invasive or proximal procedure during the hospitalization using the following hierarchy: *1*) angioplasty (ICD-9-CM 39.50), *2*) proximal vascular bypass (iliac-femoral bypass ICD-9-CM 39.25), and *3*) distal bypass ("Other peripheral vascular bypass or shunt," ICD-9-CM 39.29). The ICD-9-CM code 39.29 should not be used to identify arterio-

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Abbreviations: VA, Department of Veterans Affairs.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

Table 1—*Features of hospital discharges with ulceration by diabetes status, VA, 1998*

	Percentage with diabetes (n = 10,532)	Percentage without diabetes (n = 7,944)	Total (n = 18,476)	
			n	%
Age (years)*				
≤44	3.4	9.6	1,121	6.1
45–54	17.0	20.9	3,457	18.7
55–64	23.8	16.9	3,845	20.8
65–74	35.9	27.2	5,935	32.1
75–84	18.4	22.1	3,689	20.0
>85	1.6	3.3	429	2.3
Race*				
African American	20.0	22.1	3,860	20.9
White	70.4	70.2	12,988	70.3
Other	9.7	7.7	1,628	8.8
Married*	48.2	38.1	8,098	43.8
Peripheral vascular disease	30.3	30.9	5,645	30.6
Ulcer severity*				
Chronic ulcer	32.2	24.3	5,324	28.8
Infected ulcer or abscess	21.7	23.9	4,181	22.6
Osteomyelitis	23.1	26.8	4,563	24.7
Gangrene	18.2	12.9	2,948	16.0
Surgical complication	4.7	12.1	1,460	7.9
Additional procedures, same hospitalization				
Revascularization	4.5	5.0	873	4.7
Minor amputation (toe or foot)	13.1	5.1	1,784	9.7
Major amputation (transtibial or transfemoral)*	7.6	5.9	1,277	6.9

*$P < 0.01$.

venous shunts for renal dialysis or cardiac bypass harvest procedures, but to exclude the latter possibility, we eliminated procedures associated with codes for extracorporeal circulation (ICD-9-CM 39.61).

All lower-extremity amputations (ICD-9-CM 84.11–84.19) were identified. Procedures with the same ICD-9-CM code on the same day were considered to be a single procedure, even though they might represent bilateral amputations. They were assigned as one amputation at the most proximal level. Amputations were excluded if the diagnosis codes included cancer of the lower extremity (ICD-9-CM 170.7, 170.8, 172.7, and 173.7), 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). Lower-extremity amputations were 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. Approximately 15% of hospitalizations recorded two or more amputations; thus, the highest level of amputation during the hospitalization was used for analysis.

The indication for either the peripheral vascular procedure or amputation was classified according to the most severe diagnosis using the following hierarchy:

1. Atherosclerosis without specified complications (atherosclerosis [ICD-9-CM 440.x and 44x.x]) and peripheral vascular disease (ICD-9-CM 443.8, 443.89, and 440.21).

2. Skin ulceration, comprised of chronic ulcers (ICD-9-CM 707.0, 707.1, 707.9, and 891–894); cellulitis and abscess (681.10, 681.11, 682.6, and 682.7); or deep infection, fasciitis, and osteomyelitis (ICD-9-CM 729.4, 730.x, and 731.x); and rest pain or ulcer due to atherosclerosis (ICD-9-CM 440.22 and 440.23).

3. Gangrene, nonspecific, gas gangrene, and due to atherosclerosis (ICD-9-CM 785.4, 040.0, and 440.24).

4. Complications, including a stump infection, amputation complications (ICD-9-CM 768 and 997.6), or complications from a prior vascular graft (ICD-9-CM 440.3, 996.62, 996.7, 996.74, and E878.2).

5. Miscellaneous conditions not listed above.

The diabetic user population was defined as any veteran with three or more ambulatory care visits in 1 year with at least one visit containing a diagnosis code of diabetes (ICD-9-CM 250.x). Each veteran was counted only once. This diabetic veteran user population was used as the denominator to calculate the age-specific rates of amputation.

The hospitalization was used as the unit of analysis for assessment of ulceration, bypass procedures, and amputation. Frequencies were computed to describe hospitalizations for lower-extremity ulceration, amputation, vascular bypass, and angioplasty. Age-specific rates were calculated using the outpatient diabetes denominator. Race-specific rates were age adjusted to the 1980 male population. Statistical significance was tested with t tests, χ^2, and Pearson's χ^2.

RESULTS — During FY1998, the VA provided 18,476 hospitalizations for lower-extremity ulceration, 4,822 hospitalizations with peripheral vascular procedures, and 5,329 hospitalizations with lower-extremity amputation. Persons with diabetes comprised 57% of hospitalizations for ulceration, 34% of all hospitalizations with a peripheral vascular procedure, and 66% of hospitalizations with an amputation of the lower extremity. The overlap between the categories is noted below as each condition is described. Over 99.9% of the discharges were male, so no comparisons by sex are shown.

The features of veterans with diabetes discharged with lower-extremity ulceration are noted in Table 1. When hospital discharges were compared by diabetes status, those with diabetes had an older mean age (64.9 vs. 63.5 years, $P < 0.0001$), were less likely to be African American (20.0 vs. 22.1%, $P < 0.01$), and were more likely to be of other nonwhite or nonspecified race (9.7 vs. 7.7%, $P < 0.01$). Both groups were equally likely to have undergone a peripheral revascularization (4.5 vs. 5.0%, $P = 0.10$), but those with diabetes were more likely to also undergo minor amputation (13.1 vs. 5.1%,

Table 2—*Features of hospital discharge with a peripheral vascular procedure by diabetes status, VA, 1998*

	Percentage with diabetes (n = 1,649)	Percentage without diabetes (n = 3,173)	Total (n = 4,822)	
			n	%
Age (years)†				
≤44	0.9	2.7	100	2.1
45–54	11.0	17.8	747	15.5
55–64	27.6	27.1	1,314	27.3
65–74	39.9	35.1	1,770	36.7
75–84	20.1	16.6	857	17.8
>85	0.6	0.8	34	0.7
Race†				
African American	14.6	11.0	590	12.2
White	53.5	61.4	2,831	58.7
Other	32.0	27.5	1,401	29.1
Married†	53.2	45.1	2,308	47.9
Renal disease†	9.8	4.8	314	6.5
Peripheral vascular procedure during same hospitalization				
Angioplasty alone	24.5	27.5	1,275	26.4
Proximal bypass ± angioplasty	10.9	23.9	937	19.4
Distal bypass ± angioplasty and/or proximal bypass	64.6	48.7	2,610	54.1
Indications for bypass†				
Atherosclerosis alone	30.2	52.9	2,177	45.2
Ulcer, osteomyelitis	25.5	15.9	925	19.2
Gangrene	23.8	7.3	624	12.9
Complication from vascular or orthopedic surgery	16.0	16.9	801	16.6
Other conditions	4.4	7.0	295	6.1
Two or more bypass procedures during the same hospitalization*	5.5	3.8	213	4.4
Amputation during same hospitalization†‡				
Minor (toe or transmetatarsal)	17.9	4.9	451	9.3
Major (transtibial or transfemoral)	6.6	3.3	214	4.4

*$P < 0.05$; †$P < 0.01$; ‡amputations due to major trauma or cancer have been excluded.

$P < 0.01$) or major amputation (7.6 vs. 5.9%, $P < 0.01$).

The features of hospital discharges with peripheral vascular procedure by diabetes status are shown in Table 2. Discharges with a diabetes diagnosis had an older mean age as compared with those without diabetes (66.4 vs. 64.2 years, $P < 0.0001$). Veteran discharges with diabetes diagnosis were more likely to be African American (14.6 vs. 11.0%, $P < 0.01$) and less likely to be white (53.5 vs. 61.4%, $P < 0.01$). The type of vascular procedure varied by diabetes status. Discharges with diabetes were less likely to have a proximal bypass procedure (with or without angioplasty) (10.9 vs. 23.9%, $P < 0.01$) and more likely to undergo distal bypass procedures (64.6 vs. 48.7%, $P < 0.01$). The indications for the vascular procedure differed significantly by diabetes status. Discharges with a diabetes diagnosis were less likely to have a diagnosis of atherosclerosis only (30.2 vs. 52.9%, $P < 0.01$) but were more likely to report an ulcer or osteomyelitis (25.5 vs. 15.9%, $P < 0.01$) or gangrene (23.8 vs. 7.3%, $P < 0.01$). Repeat procedures and amputation during the same hospitalization also varied significantly by diabetes status. Discharges with diabetes were more likely than those without diabetes to undergo a repeat vascular procedure (5.5 vs. 3.8%, $P < 0.05$), minor amputation (17.9 vs. 4.9%, $P < 0.01$), or major amputation (6.6 vs. 3.3%, $P < 0.01$).

The features of hospital discharges with lower-extremity amputation are shown in Table 3. When compared with discharges without diabetes, those with diabetes had a lower mean age (66.1 vs. 67.1 years, $P = 0.002$), were less likely to be African American (23.8 vs. 27.4%, $P < 0.01$), and were more likely to be other nonwhite or unknown racial categories (15.1 vs. 12.0%, $P < 0.01$). Hospital discharges of veterans with a diabetes diagnosis were more likely than those without diabetes to be married (48.6 vs. 40.2%, $P < 0.01$). Discharges with diabetes were more likely than those without diabetes to report the most proximal amputation level at the toe (41.0 vs. 25.4%, $P < 0.01$), transmetatarsal (10.5 vs. 6.0%), or transtibial level (28.4 vs. 26.4%) and much less likely at the transfemoral level (20.2 vs. 42.3%, $P < 0.01$).

When compared with those without diabetes, discharges with diabetes were less likely to report atherosclerosis alone (4.3 vs. 7.5%) but were more likely to have an indication diagnosis of ulceration or osteomyelitis (32.2 vs. 22.3%, $P < 0.01$) and equally likely to report gangrene (50.5 vs. 47.1%). When compared with those without diabetes, hospital discharges with amputation and diabetes diagnosis were more likely to undergo two or more amputation procedures (14.8 vs. 10.6%, $P < 0.01$) and less likely to undergo a peripheral vascular proce-

Table 3—*Features of hospital discharges with lower-extremity amputation by diabetes status, VA, 1998*

	Percentage with diabetes (n = 3,515)	Percentage without diabetes (n = 1,814)	Total (n = 5,329)	
			n	%
Age (years)*				
≤44	2.4	3.1	139	2.7
45–54	13.4	13.6	705	13.4
55–64	23.2	18.4	1,134	21.6
65–74	38.5	36.5	1,985	37.8
75–84	21.1	25.3	1,182	22.5
>85	1.3	3.1	101	1.9
Race*				
African American	23.8	27.4	1,311	25.0
White	61.2	60.7	3,200	61.0
Other	15.1	12.0	735	14.0
Married*	48.6	40.2	2,400	45.8
Amputation level*				
Toe	41.0	25.4	1,874	35.7
Transmetatarsal	10.5	6.0	469	8.9
Transtibial	28.4	26.4	1,453	27.7
Transfemoral	20.2	42.3	1,450	27.6
Indications for amputation*†				
Atherosclerosis alone	4.3	7.5	282	5.4
Ulcer, osteomyelitis	32.2	22.3	1,515	28.9
Gangrene	50.5	47.1	2,591	49.4
Complication from other surgery (vascular, orthopedic)	10.4	18.9	696	13.3
Other (miscellaneous)	2.5	4.3	162	3.1
Two or more amputations during the same hospitalization	14.8	10.6	677	12.9
Bypass procedure or angioplasty during same hospitalization	11.6	14.7	665	12.7

*$P < 0.01$; †amputations due to major trauma or cancer have been excluded.

dure (11.6 vs. 14.7%) during the same hospitalization.

The age-specific rates of discharge with ulcer, peripheral vascular procedures, and amputation per 1,000 diabetic persons are shown in Fig. 1. The rates of ulceration and amputation increased with age, while the rates for persons with diabetes and vascular procedures did not. Diabetic amputation rates from the National Hospital Discharge Survey for 1996 are shown for comparison in Fig. 2. Diabetic amputation rates in the U.S. were higher than VA rates in all three age-groups.

CONCLUSIONS — Although veterans with diabetes comprise ~16% of the VA service population, they account for over half of all hospitalizations for lower-extremity ulceration, one-third of hospitalizations with a peripheral vascular procedure, and almost two-thirds of all hospitalizations with a lower-extremity amputation. There are few population-based reports by diabetes status for comparison with these VA rates. The 64% of VA amputations associated with diabetes is higher than the 50% reported from other U.S. populations and is probably related to the higher prevalence of diabetes in veterans and veterans treated at VA facilities as compared with the general population (1,2,6,7).

The proportion of lower-extremity amputations ascribed to diabetes in the

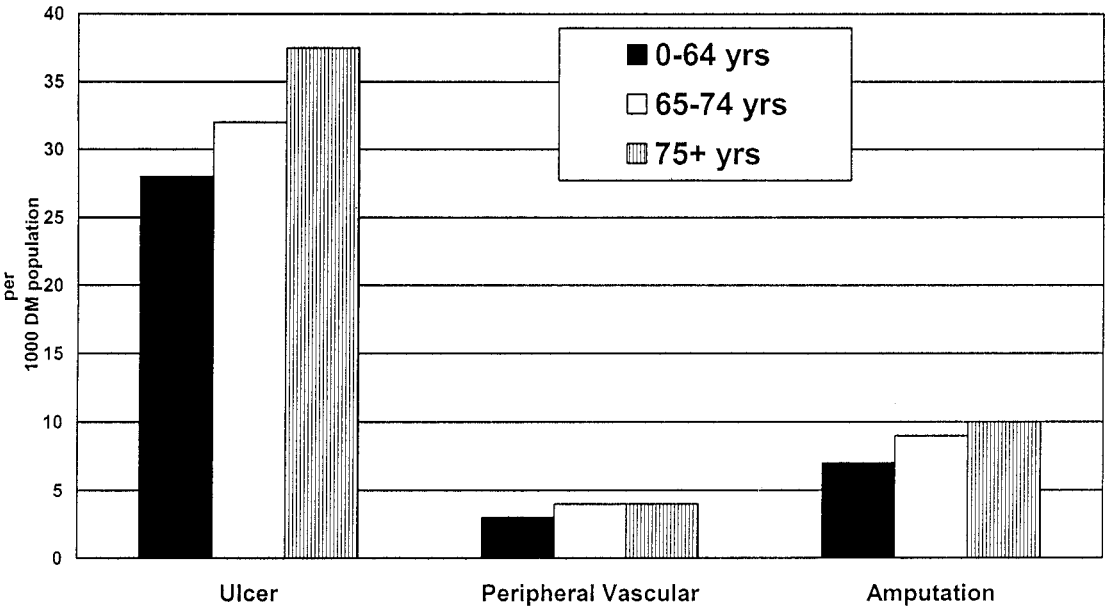

Figure 1—*Age-specific rates of discharge with ulceration, vascular procedures, and amputation per 1,000 persons with diabetes (DM), VA, 1998.*

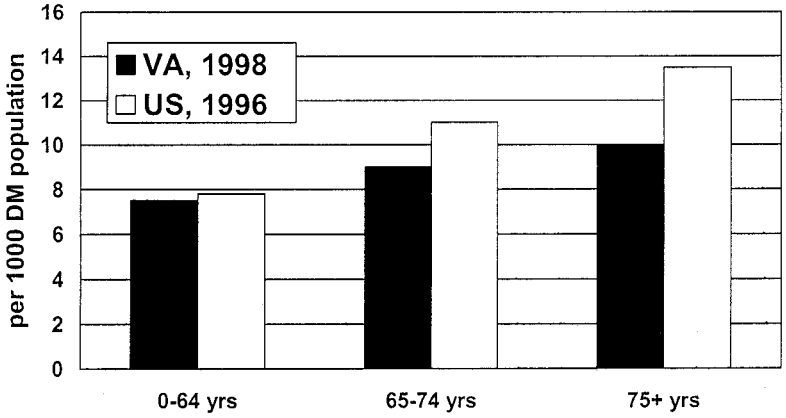

Figure 2—*Age-specific diabetic amputation rates, VA and U.S.*

VA is not only higher than rates reported in U.S. hospitals, but has increased over the last decade, from 59.3% of all amputations in 1989 to 66.4% in 1998 (2,8). The proportion of peripheral vascular procedures performed in persons with diabetes in VA facilities has also increased over the last decade, from 29.9% in 1989 to 34.2% in 1998. The increase in the proportion of these procedures reflects a decline in nondiabetic amputations and peripheral vascular procedures, while the number of diabetic amputations and vascular procedures has remained stable. The 10 trends in amputations and peripheral bypass procedures are described elsewhere (8).

The features associated with peripheral vascular procedures varied greatly by diabetes status. Vascular angioplasty and bypass were used less frequently for persons with diabetes. Discharges with diabetes were more likely to have severe indications (ulceration, osteomyelitis, and gangrene) as compared with those without diabetes (50 vs. 23%) and were more likely to come to amputation during the same hospitalization (23.5 vs. 8.2%). We were unable to locate population-based estimates of vascular bypass or ulceration by diabetes status for comparison with our data; therefore, we cannot comment on whether the utilization for these conditions and procedures is higher or lower than other populations. However, we note that only one-third of the discharges with bypass procedures were in persons with diabetes, while over half of all ulcerations and two-thirds of all discharges with amputations were in persons with diabetes. There are a number of reasons as to why the proportion of peripheral vascular procedures is dissimilar to the proportion of ulceration and amputation. First, the distribution of peripheral vascular disease in persons with diabetes tends to involve multiple sites in distal vessels of the leg, rather than occurring as a circumscribed lesion in a proximal artery (9). Thus, persons with diabetes may not have a disease distribution amenable to current vascular surgical management. It is also possible that persons with both peripheral vascular disease and diabetes do not perceive the classic symptoms of claudication or rest pain due to peripheral neuropathy and thus do not present for medical evaluation until they have developed advanced disease with complications of infection, osteomyelitis, or gangrene. Finally, it is possible that surgeons may not view persons with diabetes as suitable candidates for peripheral bypass procedures. Early studies noted poorer survival following peripheral bypass for persons with diabetes, but more recent studies have found the survival rates to be similar to those in nondiabetic populations.

The age-specific rates we calculated for the lower-extremity complications provide a means of adjusting for the changing numbers and age distribution of the population that receives care in VA facilities. The diabetes denominator we used was based on outpatient diagnosis codes first mandated in 1996. No accurate estimates of the entire VA diabetic population were readily available before 1998, so accurate trends in diabetic ulceration, vascular procedures, and amputation cannot be calculated. The diabetes denominator was based on a criteria of at least three outpatient visits to ensure that we had selected the population that received the majority of its care within the VA, but this criteria would also undercount noncompliant persons who present rarely for care yet are known to be at higher risk for the complications. Recent VA recruitment and accurate enrollment efforts may have also influenced the denominator. Surprisingly, the VA age-specific amputation rate per diabetic person is somewhat lower than the 1998 U.S. hospital discharge rates. No comparative data on diabetic vascular bypass or ulcer hospitalization rates were available for comparison.

In summary, persons with diabetes comprise a major proportion of veterans hospitalized for ulceration of the lower extremity, one-third of discharges with peripheral vascular procedures, and two-thirds of discharges with amputation. The toll exacted by these conditions among veterans is high.

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