Foot surveillance was associated with reduced risk of major amputation among patients with diabetes

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Background

- Diabetes is the major underlying cause for most amputations in Western countries.
- The lower-extremity amputation (LEA) rates in the United States have remained highly variable despite better understanding of their causes and initiatives to reduce their incidence.
- The relationship between foot care and risk of hospitalization for lower extremity complications (LECs) has never been previously demonstrated in observational studies.

Background (continued)

- The Veterans Health Administration (VHA) for the study. More than one VHA clinic users in five had diabetes. Among them, higher rate of amputations than the US average have been observed:

  e.g., 12.2 in the VHA compared to 6.7 in the US general population per 1,000 total amputations.

- The availability of individual-level data allows more accurate determination of veteran diabetic cohorts (denominator), patients incurring amputations (numerator), and levels of amputations (e.g., major vs. minor).

Research Objectives

Our objective was to evaluate the consistency of foot surveillance among patients with diabetes

and

its association with risk of initial major lower-extremity amputations (major LEAs), a rare but most severe form of lower extremity complications.

Methods

Study Design: This was a retrospective study of veterans with diabetes using Veteran Health Administrative and Medicare claims data, covering the period of fiscal years 1997-2000 (October 1, 1996 to September 2000).

We defined fiscal year (FY) 1998 as the baseline year for obtaining the independent variables. The follow-up period was from the beginning of FY1999 until the end of FY 2000.

Methods

Population Studied: 398,778 veterans with diabetes, alive in FY 1998, and not enrolled in Medicare HMO and without prior major amputations during FY1997-1998.

Diabetes was determined using a validated approach based on having two or more diabetes-specific International Classification of Diseases, 9th edition (ICD-9-CM) codes (250.xx, 357.2, 362.0, 366.41) from inpatient or outpatient physician visits (VHA and Medicare) over the 24 month period of FY 1997 & 1998 (Miller et al., 2004) .

Methods

Dependent variable: Time to the first major LEA by the end of FY 2000. Major LEAs were defined using ICD-9-CM as transtibial (84.15, 84.16) and transfemoral (84.17-84.19) amputations.

Who were censored?

Those who had no major amputations but died (11/4%) or left fee-for-service for HMO Medicare coverage (2.5%) were censored.

Methods

Independent variables:

Foot surveillance: It includes primary and preventive footcare services determined by CPT-4 codes

(93922, 95831, 95851,99385, 99386, 99387, 99395, 99396, 99397, 99401, 99402, 99403, 99404, 99411, 99412, M0101)

in the podiatric and vascular surgery clinics during the baseline period.

We coded presence or absence of foot surveillance for each quarter in the baseline year and then summed these quarterly visit variables into a variable of consistency of foot care (range: 0-4).

Methods

- Derivation of footcare variables:

We developed our footcare variables based on expert consensus. We grouped CPT-4 codes (mainly from an encounter sheet used in a VA podiatric clinic) into conceptually similar categories (e.g., preventive, primary, and tertiary care) and considered specific foot care practices. based on our clinical experience (expert consensus).

The codes were linked to provider specialty codes from Medicare and VHA clinic stop codes to identify any visits to a podiatrist or an vascular surgeon.

Methods

- Others: age, sex, race, marital status, and medical comorbidities (cardiovascular diseases, congestive heart failure (CHF), stroke, any renal diseases).

Methods

Stratification variable:

Foot risk classification groups: We categorized individuals into four risk classification groups (0-3) according to the consensus of the International Working Group on the Diabetic Foot:

***0**: no defined foot risk condition;*

***1**: only microvascular complication including neuropathy, retinopathy or chronic kidney disease;*

***2**: having microvascular complication and presence of either foot deformity or Peripheral vascular diseases;*

***3**: having foot ulceration (cellulitis/paronychia/osteomylitis/gangarene) or minor lower-extremity amputations.*

Methods

Statistical analysis: We used Cox proportional hazard regressions to assess the association between foot surveillance and major amputations for each foot risk classification group. We also evaluated the interaction between foot risk classification group and foot surveillance.

Results

- Of the 398,778 veterans, the majority (63.5%) were in Group 0; 15.4%, 6.6%, and 14.5% were in Group 2-4, respectively.
- There were 3751 (9.4 per 1,000) incurred initial major LEAs during FY 1999-2000;
- Individuals in the more severe foot-risk group had higher major LEA rates (range: 4.3 to 30.0 per 1000).
- On average, 23.8% had annual foot surveillance.
- The percentage of individuals having foot surveillance increased with increasing severity of risk classification group: 12.9% (Group 0), 24.7% (Group 1), 44.5% (Group 2), and 60.8 % (Group 3).

Table 1 Rates of major amputation and foot surveillance for various foot risk classification groups

	Group 0	Group 1	Group 2	Group 3	*Total*
Number of individuals	253,061 (63.5%)	61,219 (15.4%)	26,497 (6.6%)	58,001 (14.5%)	*398,778 (100%)*
Major amputations (per 1000)	4.3	10.7	10.1	30.0	*9.4*
Foot surveillance (%)	12.9	24.7	44.5	60.8	*23.8*

Results

- Our multivariate Cox regression models showed that having foot surveillance reduced the risk of major LEAs, but only for patients in Groups 2 and 3 (p-value for interaction being <0.001)

  For example, patients in Group 3 who received foot surveillance consistently for 3 calendar quarters were 32% less likely to have major LEAs than patients who did not have foot surveillance: (adjusted hazard ratio(AHR)= 0.68; 95% CI: 0.58-0.79).

  In the same Group 3, those who received 4 quarters of surveillance were 42% less likely to have major LEAs (AHR=0.58, 95% CI=0.50-0.68).

Table 2 Adjusted hazard ratios (AHRs) of foot surveillance (# of quarterly visits) for major amputation

	Group 0	Group 1	Group 2	Group 3
	AHR (95% CI)	AHR (95% CI)	AHR (95% CI)	AHR (95% CI)
1 vs 0	1.41(1.14,1.73)	1.28 (1.00,1.63)	0.92 (0.65,1.31)	0.87 (0-.77,1.00)
2 vs 0	1.42 (1.08,1.86)	1.07 (0.79,1.46)	1.08 (0.74,1.57)	0.85 (0.74,0.98)
3 vs 0	1.23 (0.89, 1.70)	0.96 (0.68,1.34)	0.76 (0.48,1.19)	0.68 (0.58,0.79)
4 vs 0	0.98 (0.67,1.43)	1.01 (0.72,1.40)	0.59 (0.36,0.97)	0.58 (0.50,0.68)

Discussion

- Our results suggest that foot surveillance may be most effective in preventing major LEAs in high risk subgroups. Although there will still about 40% not having any foot surveillance care during the baseline year.

- Consistent delivery of foot surveillance services may need to be improved and prioritized for high risk individuals.

Discussion

- We used administrative data to form our foot risk classification groups based on the IWG on diabetic foot. We found that higher foot risk was associated with higher risk of initial major amputations.

- Likewise, footcare variables were also derived from administrative data. We found that patients in higher risk groups were more likely to had foot surveillance.

Conclusion

- A low proportion of veteran patients with diabetes had annual foot surveillance.

- The consistency of foot surveillance was independently associated in a graded fashion with lower risk of major amputations among individuals with diabetes at high risk for foot complications.

Foot risk codes

Conditions	Coding Scheme	Notes
Microvascular Complications		
Diabetic Retinopathy	3620','36201','36202', " "2505": all codes	ICD9 Diagnostic Code -primary codes in inpatient
Peripheral Neuropathy	'3371','3572' "2506": all codes	ICD9 Diagnostic Code -primary codes in inpatient
Chronic Kidney Disease	'58181','58381' "2504": all codes	ICD9 Diagnostic Code -primary codes in inpatient
Peripheral Vascular Diseases (PVD)	44381', '4402', '44020', '44021', '44022', '44023', '44024', '44029', '4408', '4409', '4422', '4423', '4430', '4431', '44381', '44389', '4439', '44422', '44481', "2507": all codes	ICD9 Diagnostic Code - primary codes in inpatient
Foot Deformity	7271', '75471', '71257', '7557', '7350',' 7351',' 7352', '7353', '7354', '7358', '7564', '75453', '75469', '73679') or codes in "'250.6x"	ICD9 Diagnostic codes
Minor Foot Trauma	'7094', '8248', '8252', '8260', '8389', '8385', '8450',' 84510', '84513',' 9192' ('917.xx', '924.xx', '945.xx')	ICD9 Diagnostic Code

Foot risk codes (continued)

Conditions	Coding Scheme	Notes
Outpatient Osteomyelitis	'73007', '73017'	ICD9 Diagnostic Code
Outatient Cellulitis and Paronychia	'6811','68110','68111','6826','6829','6827'	ICD9 Diagnostic Code
Outpatient Ulcers	'700','7071'	ICD9 Diagnostic Code
Outpatient Gangrene	'7854'	ICD9 Diagnostic Code
Outpatient Amputation (based on Outpatient Care Codes)	9976, 99760, 99761, 99762, 99769, V521, V4971, V4972, V4973, V4974, V4975, V4976, V4977, V521 (all cides within that category)	ICD9 Diagnostic Code.
Inpatient Osteomyelitis	'73007', '73017'	ICD9 Diagnostic Code – only Primary
Inpatient Cellulitis and Paronychia	'6811','68110','68111','6826','6829','6827'	ICD9 Diagnostic Code - – only Primary
Inpatient Ulcers	'700','7071'	ICD9 Diagnostic Code– only Primary
Inpatient Gangrene	'7854'	ICD9 Diagnostic Code– only Primary
Inpatient Amputation	'8411', '8412','8413', '8414','8415', '8416','8417','8418', '8419'	ICD9 proc codes – Any code