

PODIATRIST CARE AND OUTCOMES FOR PATIENTS WITH DIABETES AND FOOT ULCER

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ABSTRACT

The purpose of this study was to examine whether outcomes of care (amputation and hospitalization) differ between patients with diabetes who received care from podiatrists and those who did not.

Adult patients with diabetes (ICD-9-CM: 250.xx) and a diagnosis of foot ulcer (ICD-9-CM: 707.00, 707.06, 707.07, 707.09, 707.10, 707.12, 707.13, 707.14, 707.15) were found in the Thomson Reuters MarketScan® Research Databases, 2005–2008. The date of the first claim with evidence of foot ulcer was assigned as the index date. Patients with previous evidence of foot ulcer or amputation were excluded. Propensity score matching (PSM) was used to create a matched sample of patients with diabetes and podiatry visits and patients with diabetes and no podiatrist visits, based on sociodemographic variables, plan type, general health status, adherence to diabetes medications, and risk factors for amputation (patient-level and foot-level). The sample comprised 20,330 patients aged 65+ (Medicare-eligible patients with employer-sponsored supplemental insurance) and 11,766 patients aged <65 (non-Medicare-eligible commercially insured patients). Patient experience was available for up to 60 months. Cox proportional hazard models estimated the hazard of inpatient hospitalization, lower extremity amputation, and major amputation (i.e., below the knee or higher), controlling for the covariates in the PSM.

Care by podiatrists, defined as at least 1 pre-ulcer podiatry visit, was associated with lower hazards of hospitalization, amputation, and major amputation in the Medicare population. Results were similar in the non-Medicare population, where the difference in major amputation was not statistically significant ($P > 0.1$). Hazard ratios (HR) and 95% confidence intervals (CI) are presented in the table below. Results were consistent when care by podiatrists was defined as at least 3 pre-ulcer podiatry visits.

	HR	95% CI
Hospitalization		
Medicare	0.910	0.873–0.949
Non-Medicare	0.825	0.777–0.876
Amputation		
Medicare	0.820	0.707–0.952
Non-Medicare	0.852	0.725–1.002
Major Amputation		
Medicare	0.766	0.585–1.002
Non-Medicare	0.771	0.547–1.086

In a population of adults with diabetes and foot ulcer, care by podiatrists appears to prevent or delay lower extremity amputation and hospitalization.

OBJECTIVE

- To examine whether outcomes of care (amputation and hospitalization) differ between patients with diabetes and foot ulcer who received care from podiatrists prior to foot ulcer and those who did not receive care from podiatrists prior to foot ulcer.

METHODS

Data Source

- Thomson Reuters MarketScan® Research Databases, 2005–2008

- Fully adjudicated health insurance claims (inpatient medical, outpatient medical, and outpatient pharmacy) linked to enrollment and demographic data
- Commercial Database
 - Enrollees with employer-sponsored insurance from large and medium-sized firms
- Medicare Supplemental Database
 - Medicare beneficiaries (65+) with employer-sponsored supplemental insurance

Patient Selection

- Inclusion Criteria
 - Patients had to have a diagnosis of diabetes on a medical claim.
 - Diagnosis of 250.xx must have occurred on at least one inpatient or two outpatient claims separated by 30+ days.
 - Claims for diagnostic procedures (e.g., laboratory tests) were excluded.
 - Patients had to have a diagnosis code or procedure code indicating foot ulcer on a medical claim.
 - At least one claim with a diagnosis or procedure code indicating foot ulcer
 - The date of the first claim with evidence of foot ulcer was the index date for each patient.
 - Patients had to be age 18 or older on the index date.
 - Provider specialty coding (i.e., podiatrist care or other provider type) must have been available on the claims.
- Patients must have been continuously enrolled with medical and outpatient prescription drug coverage in the 12 months before the index date.

Exclusion Criteria

- Evidence of foot ulcer during the 12-month pre-index period
- Evidence of amputation during the 12-month pre-index period
- ICD-9-CM and CPT codes available from authors

Variables

- Outcome Variables
 - Time from date of first evidence of foot ulcer until each event was measured in days for three outcomes:
 - Lower extremity amputation (major and/or minor)
 - Major amputation (below the knee or higher)
 - Hospitalization

Key Explanatory Variable

- Patients were classified as having at least one podiatrist visit (case) or not (comparison) during the 12 months prior to the date of the first evidence of foot ulcer.

Control Variables

- Control variables were measured on the index date or in the year prior to the index date (comorbidities, patient-level risk factors, foot-level risk factors, health behavior)
- Demographic characteristics: age group and gender
- Geography: urban residence and US Census region
- Employment status: employee/spouse/dependent and salaried (versus hourly wage)
- Socioeconomic status (from 2000 US Census): median household income and percentage of population aged 24+ with college degree in the patient's ZIP code of residence
- Comorbidity: Charlson Comorbidity Index and number of psychiatric diagnosis groups
- Patient-level risk factors: cardiovascular, nephropathy, and eye disease
- Foot-level risk factors: peripheral arterial disease, neuropathy, foot deformity, callus, other (including cellulitis, abscess, boil, etc.)
- Health behavior: adherence to diabetes prescriptions (i.e., medication possession ratio)
- Plan characteristics: plan type (e.g., HMO) and firm-level proportion of patients with podiatrist visits (as a measure of generosity toward podiatric care)
- Time: index year and months of follow-up data available

Analytic Approach

- Propensity Score Matching
 - Patients receiving care from podiatrists were matched one-to-one with patients not receiving care from podiatrists using propensity score methods.
 - Logistic regression models of the probability of receipt of podiatrist care as a function of the control variables were estimated (propensity score). Patients receiving podiatrist care were matched to those who had not based on the value of the propensity score.
 - Propensity score matching was performed separately for commercially insured enrollees and Medicare eligible enrollees.
- Statistical Models
 - Cox proportional hazard models estimated the hazard of each outcome as a function of receipt of podiatry care and the control variables.

Sample Size

- After all inclusion and exclusion criteria were applied, the non-Medicare sample comprised 28,796 patients; the Medicare sample comprised 35,721 patients.

Differences in Baseline Characteristics

- Prior to matching, patients with podiatrist visits were significantly older and had significantly more comorbidities than patients without podiatrist visits (not shown).
- After matching, few significant differences in patient characteristics remained. Select demographic and clinical characteristics of the matched groups are shown in Table 1.

Table 1. Sample Characteristics after Matching for Patients with Diabetes and Foot Ulcer

Characteristic	Non-Medicare			Medicare		
	Podiatrist Visit (Case) n = 5,883	No Podiatrist Visit (Comparison) n = 5,883	P-Value	Podiatrist Visit (Case) n = 10,165	No Podiatrist Visit (Comparison) n = 10,165	P-Value
Age Group						
18–34	1.3%	1.0%	0.197	0.0%	0.0%	0.000
35–44	6.5%	6.6%	0.881	0.0%	0.0%	0.157
45–54	28.6%	28.8%	0.987	0.2%	0.3%	0.563
55–64	63.6%	63.8%	0.803	1.6%	1.6%	0.866
65–74	0.0%	0.0%	0.000	36.7%	37.4%	0.282
75–84	0.0%	0.0%	0.000	47.5%	47.0%	0.482
85 and older	0.0%	0.0%	0.000	14.0%	13.8%	0.557
Female	47.2%	47.8%	0.555	47.5%	46.8%	0.369
Insurance Plan Type						
Comprehensive	16.3%	15.7%	0.352	62.2%	61.9%	0.833
HMO	13.0%	13.0%	0.978	5.4%	5.5%	0.877
POS / EPO	13.0%	13.1%	0.827	1.7%	1.8%	0.450
PPO	54.1%	54.6%	0.517	29.5%	29.8%	0.679
POS with capitation	1.9%	1.8%	0.492	0.0%	0.0%	1.000
CDHP	1.2%	1.1%	0.665	0.2%	0.1%	0.060
Missing	0.6%	0.7%	0.351	1.0%	1.0%	0.777
Urban Residence	85.8%	85.9%	0.832	85.4%	85.0%	0.418
Geographic Region						
Northeast	16.4%	16.6%	0.691	12.7%	11.8%	0.066
North Central	32.9%	32.2%	0.420	43.8%	44.3%	0.480
South	39.6%	39.3%	0.792	29.8%	30.4%	0.351
West	10.7%	11.4%	0.228	13.5%	13.3%	0.805
Unknown	0.4%	0.4%	0.768	0.2%	0.1%	0.028
Median Household Income in ZIP	\$46,351 (16,853)	\$46,174 (15,728)	0.545	\$45,917 (15,499)	\$45,790 (15,341)	0.545
Percent College Graduates in ZIP	0.23 (0.13)	0.23 (0.13)	0.807	0.23 (0.13)	0.23 (0.14)	0.807
Charlson Comorbidity Index	2.50 (1.87)	2.51 (2.19)	0.892	3.07 (2.10)	3.01 (2.28)	0.892
Psychiatric Diagnosis Group	0.20 (0.56)	0.21 (0.59)	0.338	0.21 (0.59)	0.20 (0.56)	0.338
Medication Possession Ratio	0.63 (0.39)	0.61 (0.39)	0.079	0.63 (0.38)	0.62 (0.38)	0.079
Patient-Level Risk Factors						
Cardiovascular	59.0%	60.1%	0.836	68.5%	68.7%	0.740
Nephropathy	11.3%	11.7%	0.544	15.6%	15.2%	0.403
Eye	14.9%	14.6%	0.622	10.9%	10.5%	0.318
Foot-Level Risk Factors						
Neuropathy	11.1%	10.5%	0.272	6.8%	5.6%	0.000
Peripheral arterial disease	14.2%	14.0%	0.750	23.9%	22.1%	0.002
Foot deformity	9.2%	6.9%	0.000	8.5%	5.8%	0.000
Callus	1.8%	1.5%	0.127	2.1%	1.2%	0.000
Other (e.g., cellulitis, abscess, boil)	34.6%	33.6%	0.243	32.1%	28.9%	0.000

RESULTS

Results of Cox Proportional Hazard Models

- Among non-Medicare patients with foot ulcer, those seen previously by a podiatrist had a 15% lower risk of amputation and a 17% lower risk of hospitalization compared with patients not seen previously by a podiatrist ($P < 0.05$). The difference in risk of major amputation was not statistically significant between patients receiving care from podiatrists and those who did not ($P > 0.05$) (Table 2).
- Among Medicare-eligible patients with foot ulcer, those seen previously by a podiatrist had an 18% lower risk of amputation, a 23% lower risk of major amputation, and a 9% lower risk of hospitalization compared with patients not seen previously by a podiatrist (all $P < 0.05$) (Table 2).
- Kaplan-Meier curves illustrate the unadjusted amount of time to amputation; patients seen previously by a podiatrist have a longer amputation-free survival time compared with patients not seen previously by a podiatrist (Figures 1a and 1b).

Table 2. Adjusted Hazard Ratios (HR) Associated with Pre-Period Podiatric Medical Care for Patients with Diabetes and Foot Ulcer

Event	Non-Medicare Patients N = 11,766		Medicare-Eligible Patients N = 20,330	
	Adj. HR	95% CI	Adj. HR	95% CI
Amputation	0.852	0.725–1.002	0.820	0.707–0.952
Major Amputation	0.771	0.547–1.086	0.766	0.585–1.002
Hospitalization	0.825	0.777–0.876	0.910	0.873–0.949

Control variables included sociodemographic characteristics, comorbidity, patient-level risk factors, foot-level risk factors, health behavior, plan type, and time.

Sensitivity Analysis

- Analyses were replicated using the unmatched samples and the results were consistent.
- Because a larger number of podiatrist visits may have a greater clinical effect, the analyses were replicated with cases defined as at least three podiatrist visits (versus fewer than three visits) and the results were consistent.

LIMITATIONS

- This retrospective, observational study was based on codes of diagnoses, procedures, and provider type from healthcare administrative claims.
- The sample comprised patients with employer-sponsored health insurance (alone or supplemental to Medicare); the results may not generalize to other populations.

CONCLUSIONS

- In a sample of commercially insured patients with diabetes and foot ulcers (non-Medicare and Medicare-eligible with employer-sponsored supplemental insurance), care by podiatrists prior to the first evidence of foot ulcer appears to prevent or delay hospitalization and amputation.

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Figure 1a. Kaplan-Meier Curve, Unadjusted Time to Lower Extremity Amputation (Non-Medicare)

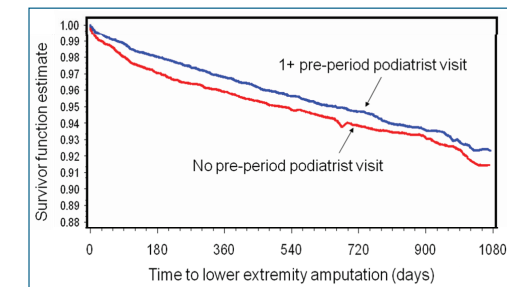


Figure 1b. Kaplan-Meier Curve, Unadjusted Time to Lower Extremity Amputation (Medicare)

