

Hospitalization and Health Service Resource Utilization in Emergency Department Cases of Diabetic Foot Infections: A Nationally-Representative Analysis

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Background

An estimated 34.1 million adults in the United States (US) have been diagnosed with diabetes, with 15-35% potentially developing a diabetic foot ulcer (DFU) in their lifetime.^{1,2} Diabetic foot infections (DFI) occur in more than half of DFUs and are associated with substantial morbidity and mortality.²

Objective

The objective of this study was to assess hospitalization and health resource utilization associated with DFI-related visits within emergency departments (ED) in the US.

Methods

Design & Analysis: Nationally-representative, cross-sectional, historical cohort analysis using bivariable generalized linear model framework

Database:

- CDC's National Hospital Ambulatory Medical Care Survey (NHAMCS) (2015-2019)

Inclusion Criteria:

- Adults ≥18 years with a diagnosis of Type 1 or Type 2 diabetes mellitus with or without a diagnosis of DFI. DFI diagnosis determined by ICD-9-CM or ICD-10-CM diagnosis codes.³ An expanded DFI criteria also included cases determined via reason for visit codes.⁴

Outcomes:

- 72-hour ED revisit; hospital admission; and inpatient length of stay
- Medication classes of drugs prescribed/used in ED

Covariates:

- Demographics (age, sex, race, primary insurance coverage); health system characteristics (rural/urban physician practice; geographic region; practitioner level); clinical characteristics (Deyo-Charlson Comorbidity Index, number of chronic conditions, Emergency Severity Index); year

Table 1. Descriptive Statistics and Outcomes (weighted)

	DFI ^a (n= 551,224)	DFI – Expanded Criteria ^b (n= 987,112)	Diabetes (n= 80,014,345)	Overall (n = 540,401,920)
Demographics				
Age (mean±SD)	56.3 ± 12.3*	54.8 ± 13.1***	60.0 ± 14.2	47.3 ± 16.6
Male (%)	60.4	58.9*	44.5	42.7
Race(%)				
White	75.1	73.0	69.9	72.6
Black	24.1	26.2	26.2	24.1
Other	0.7	0.8*	4.0	3.3
Ethnicity (%)				
Hispanic	10.1	14.1	13.4	13.3
Primary Insurance Coverage (%)				
Private Insurance	20.0	21.1	21.0	28.4
Medicare	18.8	26.3	22.5	29.4
Medicaid	35.3	32.9	37.3	21.7
Dual	11.0	8.0	11.8	5.5
Other	14.9	11.7	7.4	15.1
Health System Characteristics				
Rural Physician Practice (%) [†]	10.5	12.2	16.4	16.0
Geographic Region (%)				
Northeast	17.2	15.2	14.6	16.2
Midwest	25.1	27.4	23.4	22.3
South	28.9	31.8	42.0	40.1
West	28.8	25.6	20.0	21.3
Physician Assistant or Nurse Practitioner ^c	8.7	9.1	8.3	11.1
Clinical Characteristics				
Deyo-Charlson Comorbidity Index, mean ±SD	1.9 ± 1.3	1.8 ± 1.2	2.0 ± 1.2	0.7 ± 1.0
One Chronic Condition	63.3	62.1*	50.1	20.5
Two or More Chronic Conditions	36.7	37.9*	49.9	14.9
Emergency Severity Index				
Level 1 (Immediate)	8.5	9.3	8.3	7.6
Level 2 (Emergent)	8.1***	6.6***	31.0	27.7
Level 3 (Urgent)	38.0	34.9	28.0	27.9
Level 4 (Semi-Urgent)	10.3	11.0	5.3	7.6
Level 5 (Non-Urgent)	35.2	38.2*	27.4	29.3
Sepsis (%)	11.8**	8.0**	1.6	0.8
Year (%)				
2015	40.4***	26.2*	18.2	19.5
2016	28.1	23.8	19.4	21.0
2017	4.7**	15.3	20.5	19.5
2018	12.7	14.7	19.6	18.6
2019	14.1	19.9	22.3	21.5
Health Service Outcomes				
Seen in ED in Last 72 Hours (%)	11.4*	8.2	4.7	4.2
Admission to Hospital (%)	49.0***	37.6**	25.4	13.9
Length of Stay in Hospital (days), mean ±SD	7.6 ± 5.2	8.0 ± 5.7*	5.7 ± 4.6	5.3 ± 4.2

Data are mean ± SD or %. Unweighted Sample Sizes: DFI=74; DFI Expanded Criteria=112; Diabetes=10,659; Overall=75,154.

*** p<0.001; ** p<0.01; * p<0.05 (independent group t test or χ^2 vs. patients with diabetes without DFI).

^a DFI cases determined using ICD-9-CM and ICD-10-CM diagnosis codes.

^b DFI expanded criteria cases determined using ICD-9-CM and ICD-10-CM diagnosis codes and "reason for visit" codes.

^c Case involving Physician Assistant or Nurse Practitioner without Physician.

Abbreviations: DFU=Diabetic Foot Ulcer; DFI=Diabetic Foot Infection; SD=standard deviation; ED=Emergency Department.

Rural practice facility designated as non-MSA (metropolitan statistical area).

Results

Descriptive statistics:

- An estimated 80.6 million ED visits included a diabetes diagnosis, with 551,224 DFI cases (0.7%). The expanded DFI criteria included 987,112 cases (1.2%).
- DFI cases were significantly younger relative to diabetes-only cases (56.7 ± 11.6 years vs. 60.0 ± 13.5, p=0.046), and involved 60.4% males and 75.1% white race.
- Sepsis was present in a significantly higher proportion of DFI cases than cases with diabetes-only (11.8% vs. 1.6%, p=0.001).
- Anti-infective medications were the most frequently-prescribed medication class in 88.2% of DFI cases, significantly higher than 23.3% of diabetes-only cases (p<0.001).

Outcomes:

- DFI ED visits involved significantly:
 - More 72-hour ED revisits (11.4% vs. 4.7%, p=0.029);
 - More Hospital admissions (49.0% vs. 25.4%, p<0.001);
 - Higher odds of 72-hour ED revisit (2.6 times higher, p=0.029);
 - And higher odds of hospital admission (2.8 times higher, p<0.001).
- Length of stay was not significantly different between groups (p=0.131) and averaged 7.6 ± 5.4 days for DFIs.
- In the expanded criteria, DFI cases did not significantly differ in 72-hour ED revisits but did have significantly longer lengths of stays (8.1 days vs. 5.7, p=0.044).
- In the expanded criteria, DFI cases were more frequently admitted to a hospital, having a 77% higher odds of any admission (p=0.005).

Limitations

- Long-term longitudinal analyses for readmissions are not feasible using CDC NHAMCS data.
- To retain confidentiality, the CDC NHAMCS dataset is fully de-identified and anonymized to define the unit analysis as the ED visit rather than the patient.
- Caution is warranted in generalizing findings to specific populations or health systems.

Conclusions

This nationally-representative study of DFI-related ED visits in the US observed a 2.6- and 2.8-times higher odds of 72-hour ED revisits and hospitalizations, respectively, for DFIs versus diabetes without foot complications. Further research should seek to assess and develop prevention and coordinated treatment interventions prior to the emergence of DFIs requiring ED care.

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