Medical, Drug, and Work-Loss Costs of Diabetic Foot Ulcers

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Background and Objective

**Background:**

- According to the American Diabetes Association, the annual cost of diabetes, which affects 25.8 million people in the U.S., was $245 billion in 2012 – $176 billion in direct medical costs and $69 billion in reduced workforce productivity\(^1,2\)
  
  - One common complication of diabetes is the development of foot ulcers
    
    - Foot ulcers have been estimated to affect 1% to 6% of patients with diabetes annually and up to 25% of diabetes patients over their lifetime\(^3,4\)
  
  - While diabetes patients with foot ulcers can require substantial amounts of resource use, little is known about the burden of these ulcers imposed on the U.S. healthcare system and payers

**Objective:**

- Estimate annual per-patient medical, prescription drug, and work-loss costs of diabetic foot ulcers (DFUs) using de-identified administrative claims data
  
  - For this purpose, DFU patients and non-DFU patients with diabetes (controls) were identified using two databases: ages 65+ from a 5% random sample of Medicare beneficiaries (Standard Analytical Files) and ages 18–64 from a privately-insured population (OptumInsight)
**Periods of Analysis**

**Diagnosis period**
Patients with a DFU diagnosis during 2007–2011* were identified, with the date of each patient’s most recent episode in this timeframe defined as the index date (the index date for the control group was randomly assigned to ensure similar timing distribution).

**Baseline period**
Patient characteristics in the 12 months prior to treatment were assessed to create treatment and control groups with comparable characteristics.

**Follow-up period**
Resource use and costs of treatment and control groups were compared for 12 months post-index to determine burden of illness.

* Medicare analysis through 2010
Sample Selection and Patient Counts

1. Identify all patients with medical claims (

2. Identify relevant patient population

3. Ensure complete visibility of medical and
   pharmacy utilization

4. Identify the first date of new ulcer episodes

5. Identify index date

Patient characteristics are analyzed among treatment and control groups

Patients with at least one medical claim
- Private ins.: N = 8,398,397
- Medicare: N = 2,285,018

Treatment

- > 1 foot ulcer diagnoses in relevant period following > 2 diabetes diagnoses

Control

- > 2 diabetes diagnoses in medical history, but no foot ulcer diagnoses in the relevant time period

Continuous (non HMO) coverage, and age restrictions in the study period

- No foot ulcer claims in the 12 months preceding a recent foot ulcer claim

Select most recent episode

Analytical sample
- Private ins.: n = 5,681
- Medicare: n = 29,681

Potential controls
- Private ins.: n = 113,337
- Medicare: n = 201,757
Propensity Score Matching and Outcomes

Propensity score matching:

- To provide an unbiased estimation of the incremental costs due to DFU, DFU patients were matched to patients in the non-DFU diabetic control population using a “greedy” matching method based on:
  - Gender
  - Year of index date
  - Baseline healthcare costs (+/- 10%)
  - Propensity score (within ¼ std. dev.) – variables include age, comorbidities, medical resource use, and prescription drug use (private insurance only)

Outcomes:

- Total and incremental direct healthcare as well as work-loss costs in the 12 months post-index were estimated for DFU and matched control patients
  - Healthcare costs were estimated overall and for selected services containing a diagnosis or procedure code for ulcers, ulcer-related infections, or amputation recorded on the claim
  - Work-loss costs were estimated for the subgroup of privately-insured patients with disability and wage information available following Birnbaum et al. (2000)
### Pre- and Post-Match Baseline Characteristics

**Although the DFU patients differed from the control population on nearly all baseline characteristics, these differences were largely eliminated after matching**

Selected baseline characteristics among DFU patients and non-DFU diabetic controls

<table>
<thead>
<tr>
<th>Private insurance</th>
<th>Pre-match</th>
<th>Post-match</th>
</tr>
</thead>
<tbody>
<tr>
<td>DFU n = 5,681</td>
<td>Non-DFU controls n = 113,337</td>
<td>DFU n = 4,536</td>
</tr>
<tr>
<td><strong>Male, %</strong></td>
<td>59.7%</td>
<td>55.0%*</td>
</tr>
<tr>
<td><strong>Age, mean</strong></td>
<td>55.3</td>
<td>52.8*</td>
</tr>
<tr>
<td><strong>Comorbid conditions, %</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes w/ complications</td>
<td>43.8%</td>
<td>14.2%*</td>
</tr>
<tr>
<td>Peripheral vascular disease</td>
<td>15.2%</td>
<td>3.5%*</td>
</tr>
<tr>
<td>Renal disease</td>
<td>14.1%</td>
<td>3.1%*</td>
</tr>
<tr>
<td>Depression</td>
<td>10.7%</td>
<td>7.7%*</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>10.5%</td>
<td>4.4%*</td>
</tr>
<tr>
<td>COPD</td>
<td>7.9%</td>
<td>3.4%*</td>
</tr>
<tr>
<td>Malignancies (incl. leukemia)</td>
<td>6.6%</td>
<td>4.9%*</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>3.5%</td>
<td>1.7%*</td>
</tr>
<tr>
<td><strong>Healthcare costs, mean</strong></td>
<td>$30,718</td>
<td>$12,338*</td>
</tr>
</tbody>
</table>

Note: 8 of 17 comorbidities included in the propensity score shown.

* Statistically different from the DFU cohort at p<0.05.
Results: Per-Patient Annual All-Cause Healthcare Cost Differential

DFU patients were over twice as costly as diabetic patients for private insurers and almost twice as costly for Medicare

Per patient costs

Private insurance

- DFU patients: $30,309
- Matched non-DFU diabetic controls: $9,316

Medicare

- DFU patients: $27,040
- Matched non-DFU diabetic controls: $5,098

Note: “Selected services” include those with a diagnosis or procedure code for ulcers, ulcer-related infections, or amputation recorded on the claim.
Results: Components of Cost Differential

Inpatient and outpatient services comprised almost 75% of the cost differential for private insurance, with a more even distribution across places of service in Medicare.

* Includes use of nursing home care, skilled nursing facilities, rehabilitation centers, hospice, durable medical equipment, and some specialist services (e.g., chiropractor).
Results: Annual Incremental Payer Burden of DFU

Using publicly-available incidence estimates, the estimated annual U.S. burden of illness is in the range of $10–$15 billion

DFU per-patient healthcare cost differential
$11,296–$16,286

\[ \times \] 0.9 million patients / year\(^1\)

Estimated DFU annual payer burden =

$10–$15 billion

+ Work-loss and other indirect costs

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1. Estimated based on Type 2 diabetes population of 25.8 million and the midpoint (3.5%) of annual DFU incidence estimates.\(^1,3,4\)
Limitations and Conclusions

Limitations:

- As with any claims data analysis, this analysis is based on ICD-9 and CPT codes to identify diagnoses and procedures as opposed to actual observance of medical conditions and resource use

- Results may not generalize to other patient populations (e.g., Medicaid)

- Results potentially underestimate incremental burden due to factors such as:
  - Costs not covered through Medicare (supplemental insurance)
  - Excludes additional indirect costs (e.g., quality of life)
  - Disproportionate removal of relatively high-cost DFU patients during the matching process

Conclusions:

- After accounting for differences in baseline characteristics, DFU patients had significantly higher medical resource use, resulting in them being approximately twice as expensive as the matched controls

- The incremental annual cost of DFU is in the range of $10–$15 billion, suggesting that presence of DFU imposes substantial burden on payers beyond that of care for diabetes alone

- The study highlights the need for improved preventive measures and optimized treatment for DFUs to help avoid some severe and costly outcomes such as amputation
References


