

FACTORS ASSOCIATED WITH HEALTHCARE COSTS AMONG ELDERLY PATIENTS WITH DIABETIC NEUROPATHY

**Luke Boulanger, MA, MBA¹, Yang Zhao, PhD²,
YanJun Bao, PhD¹, Cassie Cai, MS, MSPH¹, Wenyu
Ye, PhD², Mason W Russell, MAPE¹**

¹Health Economic Research and Quality of Life Evaluation, Abt Associates Inc., Lexington, MA

²Eli Lilly and Company, Indianapolis, IN

ABSTRACT

INTRODUCTION: There is limited data on the economic impact of mood disorders among patients with diabetic neuropathy (DN).

OBJECTIVE: This study examines factors associated with healthcare costs among elderly DN patients with or without depression/anxiety (DA).

METHODS: Using a retrospective cohort design and administrative claims data, we assessed the predictors of total healthcare costs over a one-year follow-up period for over-age-65 patients with 1+ diagnosis of DN. The index date was defined as the first observed medical claim with a diagnosis for DN in 2005. Patients with continuous eligibility for 12 months prior to and following the index date were included. Two cohorts of patients were constructed for individuals with DA (DN-DA) or without (DN-only). Multivariate linear regression was performed to assess whether DN-DA patients have higher healthcare costs than DN-only patients, controlling for demographic and clinical characteristics (diabetes-related comorbidities and treatment regimen for diabetes observed within 12 months prior to index date).

RESULTS: We identified 16,831 DN-only patients, and 1,699 DN-DA patients. The DN-only and DN-DA groups were similar by age (75.6 vs. 75.4, $p=0.44$), but DN-DA patients were more likely to be female (56% vs. 47%, $p<0.01$). DN-DA patients had higher prevalence of diabetes-related comorbidities for cardiovascular disease, nephropathy, neuropathy, obesity, and hypoglycemic events than DN-only patients (all $p<0.01$). Controlling for differences in demographic and clinical characteristics, DN-DA patients had \$9,785 ($p<0.01$) higher total healthcare costs than patients with DN-only. Factors associated with increased costs included insurance type, geographical region, diabetes-related comorbidities, and insulin therapy.

CONCLUSION: These findings indicate that the healthcare costs were significantly higher for DN patients with depression/anxiety relative to those without these mood disorders.

BACKGROUND

- Diabetic neuropathy (DN) is a common complication of diabetes mellitus, in which nerves are damaged as a result of hyperglycemia and painful DN manifests itself as an electric, burning, or shooting sensation
- Estimated 28% of DN patients have depression and 35% have moderate to severe anxiety (Gore et al., 2004a; Gore et al., 2004b)
- The economic burden of DN is significant as the total annual direct costs of the condition and its complications in the U.S. were estimated to be \$4.6 -13.7 billion in 2001 (Gordois et al., 2003)
- No study has examined the effects of concomitant mood disorders on direct healthcare-related resource use and costs among DN patients

STUDY OBJECTIVES

- Among Medicare eligible DN patients covered by employer-sponsored supplemental insurance, the aims of this study were to assess the following objectives between DN patients with versus without mood disorders
 - Profile demographic and clinical characteristics
 - Assess patterns of healthcare resource utilization
 - Quantify direct healthcare costs of DN and evaluate associated demographic and clinical predictors

STUDY METHODOLOGY

Overview of Methodology Employed

- Retrospective cohort design employing a Medicare supplemental insurance database
- Resource use and associated costs were assessed between elderly DN patients with concomitant mood disorders versus those without such conditions
- Applied multivariate regression analysis to examine the effects of having concomitant mood disorders on the likelihood and number of healthcare services, as well as on costs after controlling for baseline demographic and clinical characteristics

Study Database

- The Thomson Medstat MarketScan database (2004-2006) was used for this study, which consists of several linkable files (based on an encrypted patient identification number): an enrollment file, a pharmacy file, and four medical services files

Patient Selection and Cohort Identification

- Patients 65+ years of age were required to have one or more 2005 medical visits with an associated diagnosis of diabetes (ICD-9-CM code 250.xx) and DN (ICD-9-CM code 250.6 or 357.2) and the first observed DN claim was set as the “index date”
- Health enrollment requirement: continuous enrollment from 12 months prior to the index date through 12 months following the index date (i.e., the “study period”)
- Study cohort construction:
 - DN-DA cohort consists of selected DN patients who had ≥ 1 medical claim for depression (296.2, 296.3, 300.4, 309.1, 311) or anxiety disorders (300.0x, 300.2x, 300.3, 309.81) during the study period
 - DN-only cohort contains DN patients without any claim for depression or anxiety disorders during the study period

Study Measures and Data Analysis

- Healthcare resource utilization and direct costs by component in the 12 months following the index date.
 - Inpatient admissions (i.e., hospital, skilled nursing facility)
 - Outpatient visits (i.e., emergency room, hospital outpatient, home healthcare, durable medical equipment, laboratory test and procedures, office visits)
 - Prescription medications
- Logistic regressions were employed to analyze effects of concomitant mood disorders on the likelihood of resource use.
- All costs were inflated to 2006 US dollars using the medical component of the consumer price index.
- Ordinary least squares (OLS) regressions were used to assess the association between concomitant mood disorders and the number of services as well as the associated costs.

RESULTS

Study sample sizes

- Total sample: 18,530 patients
- DN-DA cohort: 1,699 patients (9%)
- DN-only cohort: 16,831 patients (91%)

Baseline demographic characteristics

- The mean age was statistically no different for the DN-only cohort and the DN-DA cohort (75.6 vs. 75.4 years, $p=0.44$)
- The DN-DA cohort had a significantly higher proportion of females compared with the DN-only cohort (57% vs. 47%, $p<0.001$)

Table 1: Demographic Characteristics for DNP Patients, by Study Cohort

Characteristic	DN-only	DN-DA	p-value*
Number of patients	16,831	1,699	
Mean (SD) age	75.6 (6.1)	75.4 (6.3)	0.4424
Percent female	47.1%	55.8%	<.0001
Plan types (%):			<.0001
Comprehensive	65.2%	60.4%	
Point of Service	0.3%	0.1%	
Preferred Provider Organization	21.6%	21.9%	
Health Maintenance Organization	11.8%	16.5%	
Missing	1.1%	1.0%	
Region (%):			0.0031
Northeast	10.8%	8.5%	
Northcentral	41.3%	42.1%	
South	30.2%	28.4%	
West	16.7%	20.1%	
Missing	1.0%	0.9%	

Source: Thomson Medstat Marketscan database for patients with Medicare supplemental insurance (2002-2006)

Note: *Student t-tests were conducted for continuous variables whereas Cochran-Mantel-Haenszel tests were generated for categorical variables

Clinical Characteristics and Prior Resource Use

- There was a higher proportion of DN-DA patients with most diabetes-related comorbidities and complications as compared with the DN-only cohort
- Resource use and costs; compared with the DN-only cohort, a significantly higher proportion of DN-DA patients were (all $p < 0.001$):
 - Prescribed insulin (40% vs. 36%)
 - Hospitalized (46% vs. 28%)
 - The overall healthcare expenditures were consequently approximately \$10,000 higher for the DN-DA cohort (\$25,514 vs. \$15,332, $p < 0.001$)

Table 2: Clinical Characteristics and Prior Resource Use for DNP Patients, by Study Cohort

	DN-only	DN-DA	p-value*
Number of patients	16,831	1,699	
Diabetes-related comorbidities (%):			
Cardiovascular disease	73.2%	81.0%	<.0001
Cerebro/peripheral vascular disease	34.8%	44.4%	<.0001
Infections related to diabetes	1.9%	3.7%	<.0001
Other metabolic diseases	9.0%	19.2%	<.0001
Nephropathy	7.5%	10.4%	<.0001
Neuropathy	10.6%	14.0%	<.0001
Obesity	1.3%	3.1%	<.0001
Retinopathy	13.8%	13.7%	0.9363
Hypoglycemic events	8.9%	12.6%	<.0001
Skin problems	21.4%	25.3%	0.0003
Leg amputation	0.2%	0.3%	0.2938
Antidiabetic medications (%):			
No treatment	14.3%	15.2%	0.2788
Insulin	36.2%	40.1%	0.0014
OAD	70.6%	66.7%	0.0008
Hospital admissions (%)	28.0%	46.0%	<.0001
Mean (SD) diabetes-related healthcare expenditures	\$3,823 (\$11,783)	\$7,384 (\$21,727)	<.0001
Mean (SD) overall healthcare expenditures	\$15,332 (\$21,915)	\$25,514 (\$38,869)	<.0001

Source: Thomson Medstat Marketscan database for patients with Medicare supplemental insurance (2002-2006)

Note: *Student t-tests were conducted for continuous variables whereas Cochran-Mantel-Haenszel tests were generated for categorical variables

Resource use in the 12 months following the index date

- After adjusting for baseline characteristics, DN-DA patients (compared with DN-only patients), were:
 - Twice as likely to be hospitalized
 - 2.9 times as likely to be admitted to SNFs
 - 2.1 times as likely to have an ER visit

Table 3: Resource Utilization in the 12 Months Following Index, by Study Cohort

	DN-only	DN-DA	Adjusted Odds Ratio (CI) or Mean Difference (p-value)
Number of patients	16,831	1,699	
Hospitalization admissions			
Percentage of patients (%)	34.8%	54.3%	2.01 (1.81 to 2.23)
Mean (SD) length of stay	2.6 (8.0)	6.0 (13.4)	2.82 (p<.0001)
Skilled nursing home admissions			
Percentage of patients (%)	9.5%	25.3%	2.92 (2.56 to 3.33)
Mean (SD) number of admissions	0.8 (3.9)	3.2 (8.8)	2.11 (p<.0001)
Emergency room visits (%)	21.7%	38.8%	2.10 (1.88 to 2.33)
Hospital outpatient visits (%)	78.1%	81.9%	1.33 (1.15 to 1.53)
Community based physician visits			
Percentage of patients (%)	98.8%	98.1%	0.65 (0.44 to 0.95)
Mean (SD) number of visits	18.5 (12.9)	21.6 (15.1)	2.50 (p<.0001)
Home health care visits			
Percentage of patients (%)	52.5%	52.4%	0.99 (0.89 to 1.10)
Mean (SD) number of visits	2.2 (4.8)	2.6 (5.5)	0.23 (p=0.0603)

Source: Thomson Medstat Marketscan database for patients with Medicare supplemental insurance (2002-2006)

Note: Student t-tests were conducted for continuous variables whereas Cochran-Mantel-Haenszel tests were generated for categorical variables

Unadjusted and adjusted direct treatment costs

- Factors associated with increased costs included HMO or PPO insurance type, geographical region of west or south, diabetes-related comorbidities, and insulin therapy.
- The adjusted difference in the total healthcare costs after accounting for the baseline demographic and clinical characteristics was \$9,785 DN-DA patients relative to DN-only patients.
- Costs for inpatient services accounted for over two-thirds of the adjusted difference in healthcare costs between study cohorts

Table 4: Unadjusted and Adjusted Costs in the 12 Months Following Index, by Study Cohort

	DN-only	DN-DA	Adjusted cost difference	p-value
Mean (SD) inpatient expenditures	\$6,491 (\$19,608)	\$15,072 (\$36,836)	\$7,082	<.0001
Hospital admissions	\$5,405 (\$18,093)	\$11,544 (\$34,481)	\$4,903	<.0001
Hospital inpatient physician visits	\$424 (\$1,685)	\$947 (\$2,340)	\$453	<.0001
Skilled nursing home	\$661 (\$4,040)	\$2,581 (\$8,326)	\$1,725	<.0001
Mean (SD) outpatient expenditures	\$7,296 (\$13,751)	\$10,154 (\$22,626)	\$1,917	<.0001
Emergency room	\$89 (\$452)	\$229 (\$797)	\$116	<.0001
Hospital outpatient	\$2,606 (\$9,397)	\$3,550 (\$7,589)	\$599	0.0109
Home health care	\$532 (\$2,797)	\$614 (\$2,063)	\$9	0.9027
Lab tests and diagnostic procedures	\$70 (\$248)	\$121 (\$742)	\$22	0.0003
Durable medical equipment services	\$218 (\$880)	\$342 (\$1,058)	\$101	<.0001
Community based physician visits	\$2,959 (\$4,556)	\$3,435 (\$3,921)	\$303	0.0079
Ambulatory surgical center	\$209 (\$980)	\$208 (\$835)	-\$26	0.2866
Ambulance	\$96 (\$849)	\$321 (\$1,687)	\$194	<.0001
Other	\$516 (\$6,120)	\$1,333 (\$17,419)	\$599	0.0031
Mean (SD) medication expenditures	\$4,286 (\$3,913)	\$5,185 (\$4,708)	\$787	<.0001
Anti-diabetic medications (mean, SD)	\$874 (\$994)	\$728 (\$870)	-\$108	<.0001
DNP-related medications (mean, SD)	\$189 (\$549)	\$364 (\$743)	\$161	<.0001
Mean (SD) total healthcare expenditures	\$18,072 (26,660)	\$30,410 (\$46,083)	\$9,785	<.0001

Source: Thomson Medstat Marketscan database for patients with Medicare supplemental insurance (2002-2006)

CONCLUSIONS

- Compared with DN-only patients, DN-DA patients not only were more likely to use healthcare resources by component, but also were associated with higher levels of utilization for each service
- The total healthcare expenditures, overall and by component, were significantly higher among DN-DA patients than for DN-only patients

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